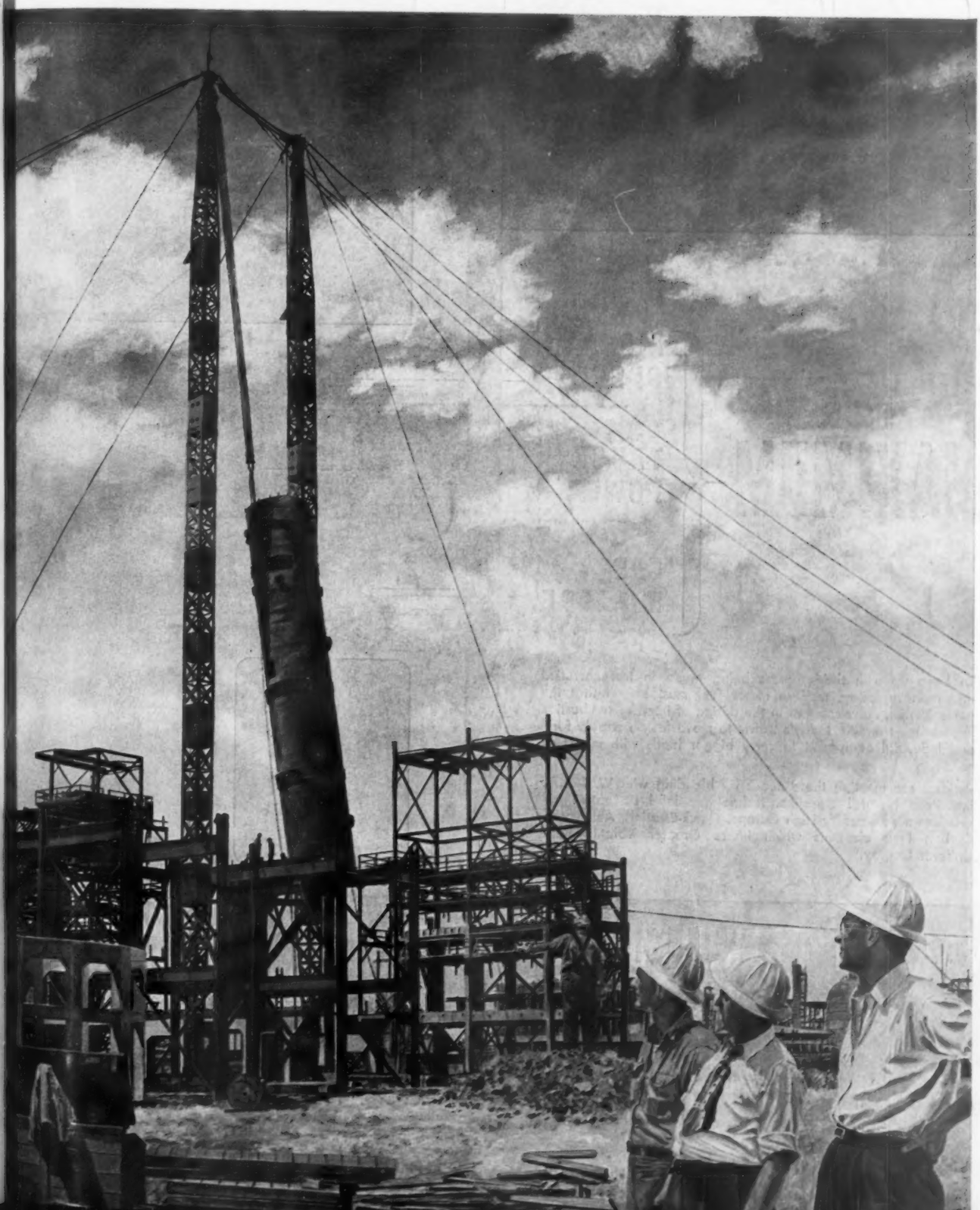
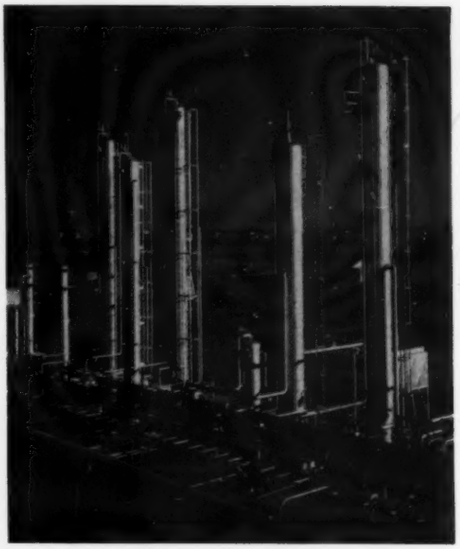
World Petroleum



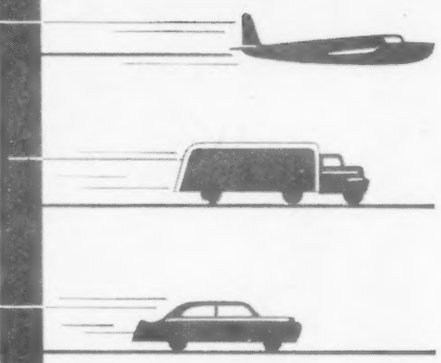
TWENTIETH ANNUAL REFINERY ISSUE • 1950 • ONE DOLLAR

WARREN'S *Stabilized* NATURAL GASOLINE OR STA-VOL-ENE



FOR MAXIMUM

- AIR SPEED
- TRUCK POWER
- CAR MILEAGE



To keep up with the progress being made in transportation and industry today, modern motor fuel must be all that the name implies. Advancement in the design of internal combustion engines must enable today's traffic to move faster; enable farm and industrial equipment to carry bigger loads with increased safety.

Refiners are meeting these needs by blending with WARREN'S Stabilized Natural Gasoline. It has fine lead susceptibility — provides the necessary High Octane, Quick-Starting, Anti-Knock, Carbon Free elements which insure Greater Volatility and Uniform Quality.

NATURAL GASOLINE
Butane
Propane
Iso-Butane
Iso-Pentane
Hexane
Heptane
STA-VOL-ENE

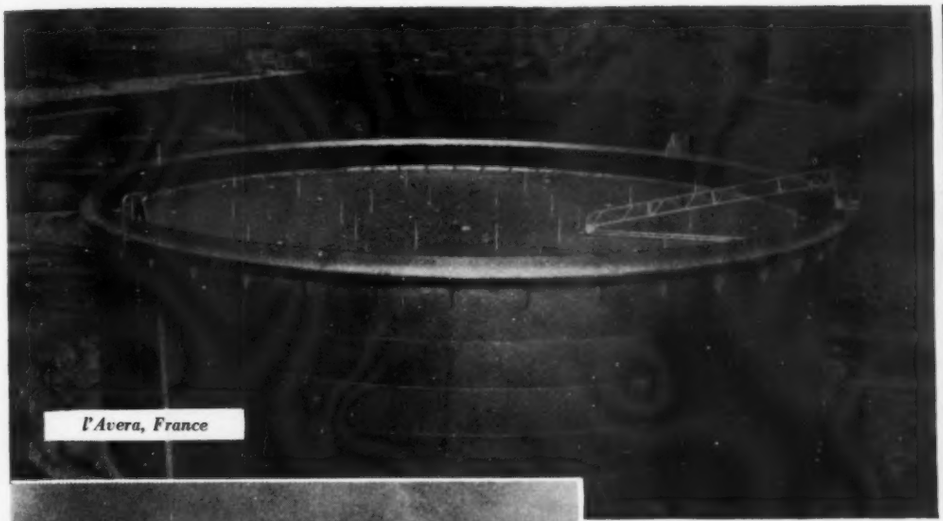
WARREN PETROLEUM CORPORATION

Producers, Manufacturers, Exporters and Marketers

Export Terminals: Corpus Christi, Port Arthur, Baytown, Texas City, and Norsworthy, Houston, Texas.

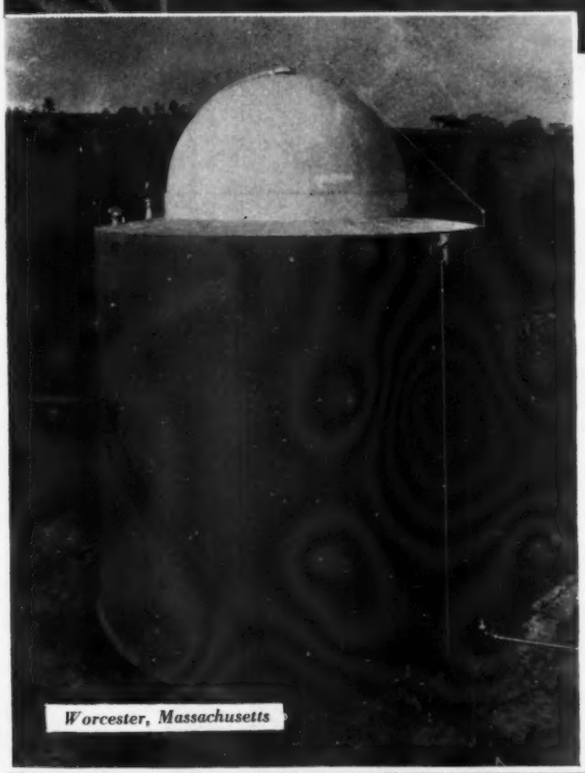
TULSA 2, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

Crude Oil, Natural Gasoline and Liquefied Petroleum Products



l'Avera, France

3 Methods of preventing Evaporation Losses



Worcester, Massachusetts

1. *ELIMINATION OF VAPOR SPACE*—The vapor space in a flat-bottom storage tank is eliminated by installing a Horton Floating Roof. Since it floats directly on the liquid, there is no air-vapor mixture under the roof. As a result, evaporation losses are decreased, the fire hazard is reduced and there is less corrosion on the underside of the roof. Horton Floating Roofs are available in three types . . . DOUBLE-DECK, PONTOON, and PAN.

Above: 120,000-bbl. oil storage tank equipped with a Horton Double-Deck Floating Roof. Our licensee, Constructions Metalliques de Provence, built the tank and roof for Compagnie Francaise de Raffinage at l'Avera, France. It shows how a Horton Roof floats on the liquid.

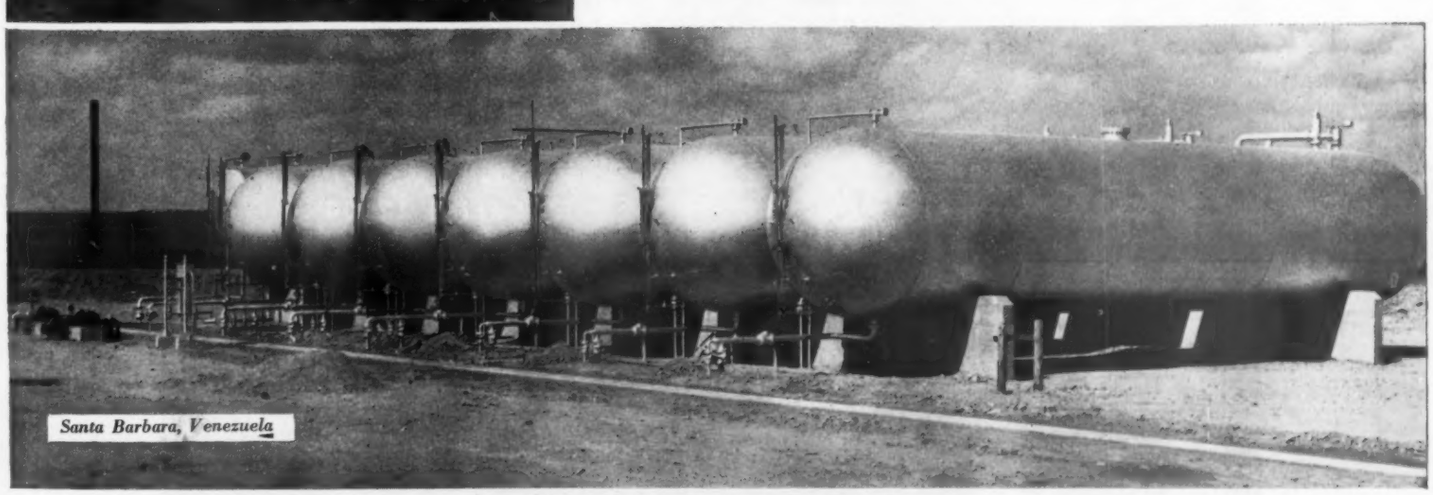
2. *TEMPORARY VAPOR STORAGE*—This method provides facilities for storing temporarily all of the additional vapor volume caused by breathing and part of the volume caused by unbalanced pumping. Horton Vapordome Roofs, Vaporspheres, and Lifter Roofs are used for this purpose. Vapordome Roofs and Lifter Roofs are installed on flat-bottom tanks to serve one or more tanks. The Vaporsphere is an independent vapor storage unit connected to one or more tanks.

Left: 17,000-bbl. motor gasoline storage tank equipped with a Horton Vapordome Roof at the Socony-Vacuum Oil Company's Worcester, Mass., terminal.

3. *PRESSURE STORAGE*—This method of reducing evaporation losses makes use of storage tanks that are able to withstand the pressure changes that occur under storage conditions. As long as the pressure in the tank does not exceed the relief valve setting, there will be no evaporation loss.

We fabricate and erect four types of pressure storage tanks—Hemispheroids, Hortonspheroids, Hortonspheres and cylindrical pressure tanks. You can get complete information about these structures—and all other Horton tanks—by writing our nearest office.

Below: Horizontal tanks at Santa Barbara, Venezuela, cycling plant of the Compania Consolidada de Petroleo storing propane, natural gasoline, and motor fuel under pressure.



Santa Barbara, Venezuela

CHICAGO BRIDGE & IRON COMPANY

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Plants: Birmingham, Chicago, Salt Lake City and Greenville, Pa., U.S.A. Export Office—165 Broadway Building, New York 6, N. Y., U.S.A.

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Whessoe, Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Horton Steel Works, Limited, Fort Erie, Ontario, Canada
W. P. Bryant, Edifico Abreu 402, Havana, Cuba
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NEW

SERIES 12100*

FORGED STEEL

DROP

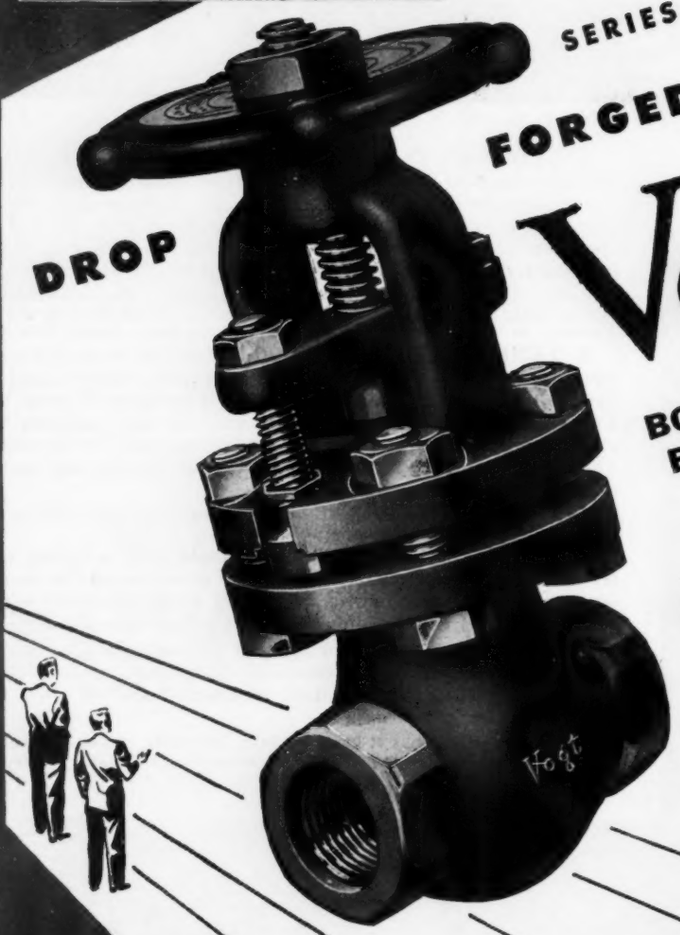
Vogt

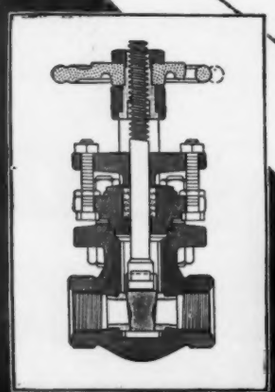
BOLTED BONNET
BOLTED GLAND

150-800 POUND

GATE VALVES

SIZES 1/4" to 2"





*Series 12100

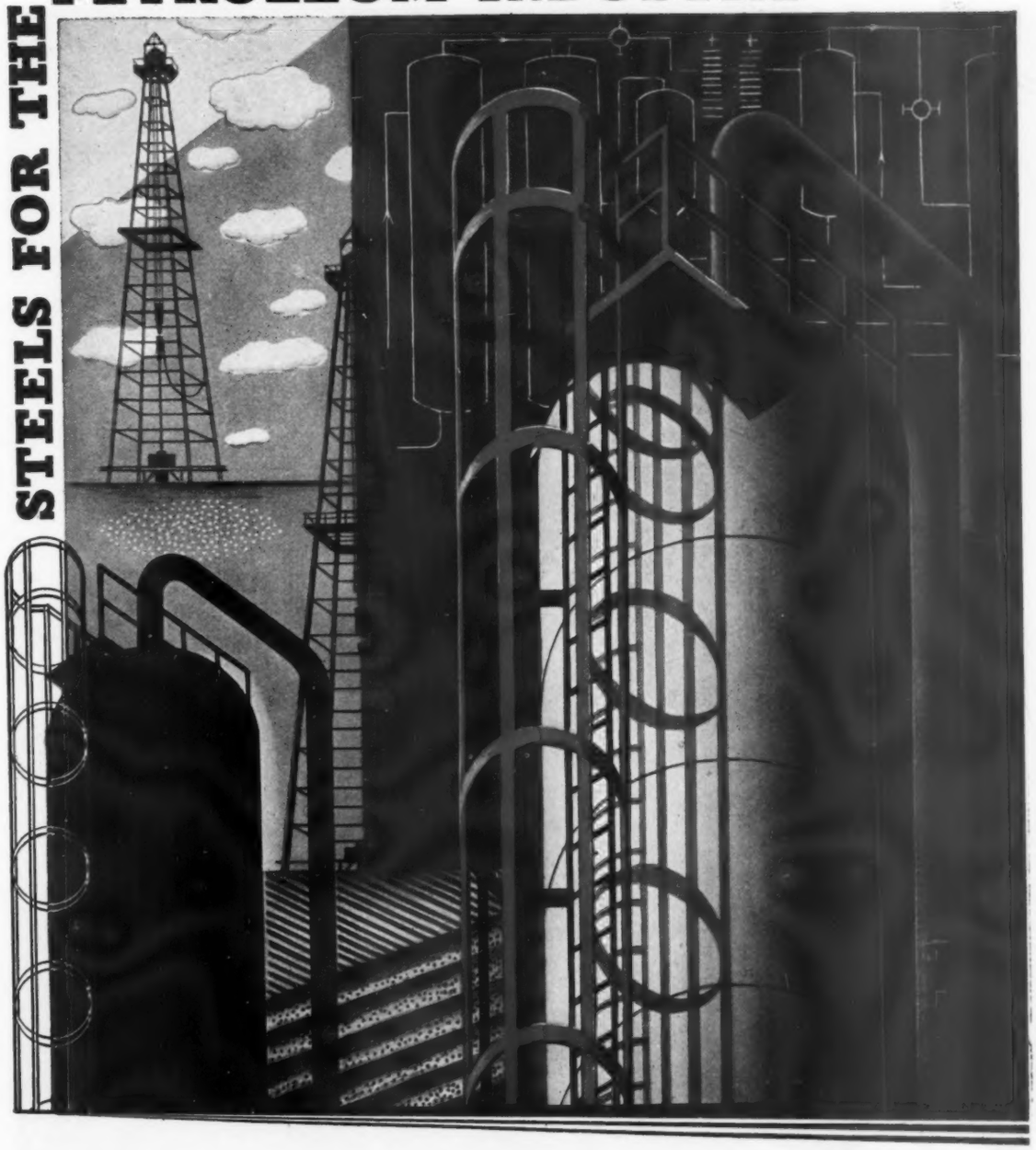
CARBON STEEL } 800 Pounds @ 750° F.
1500 Pounds Cold Non-Shock

For 150-800 pounds service • Round Bolted Bonnet • Bolted Gland • Gasket or Ground Joint • Outside Screw and Yoke • Renewable Seat Rings • Solid Wedge — Slotted Type • Rising Stem 11½-13% Chrome Stainless Steel Trimmings • Sizes 1/4" to 2" inclusive.

HENRY VOGT MACHINE CO. *Louisville 10, Ky.*

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • ST. LOUIS • DALLAS

STEELS FOR THE PETROLEUM INDUSTRY



THE UNITED STEEL COMPANIES LTD

This organisation has made a special study of steel requirements of the petroleum industry: plates for fusion welded vessels; constructional steel; forgings; alloy steels, including corrosion and heat-resisting types; etc. The Technical Departments will be pleased to discuss specific applications with manufacturers of petroleum equipment.

THE UNITED STEEL COMPANIES LIMITED

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US34

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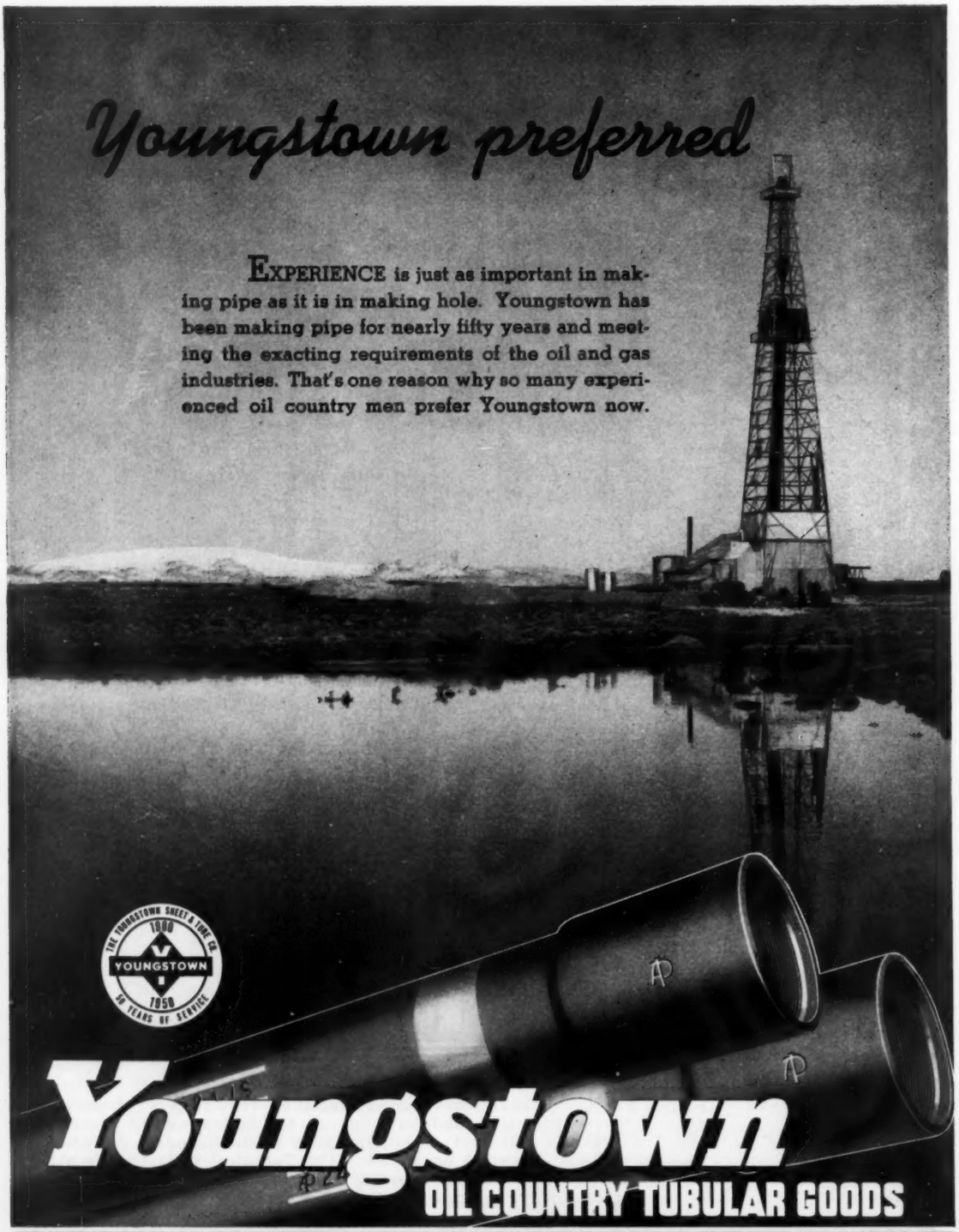
Youngstown preferred
EXPERIENCE is just as important in making pipe as it is in making hole. Youngstown has been making pipe for nearly fifty years and meeting the exacting requirements of the oil and gas industries. That's one reason why so many experienced oil country men prefer Youngstown now.
THE YOUNGSTOWN SHEET & TUBE CO
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50 YEARS OF SERVICE
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OIL COUNTRY TUBULAR GOODS

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

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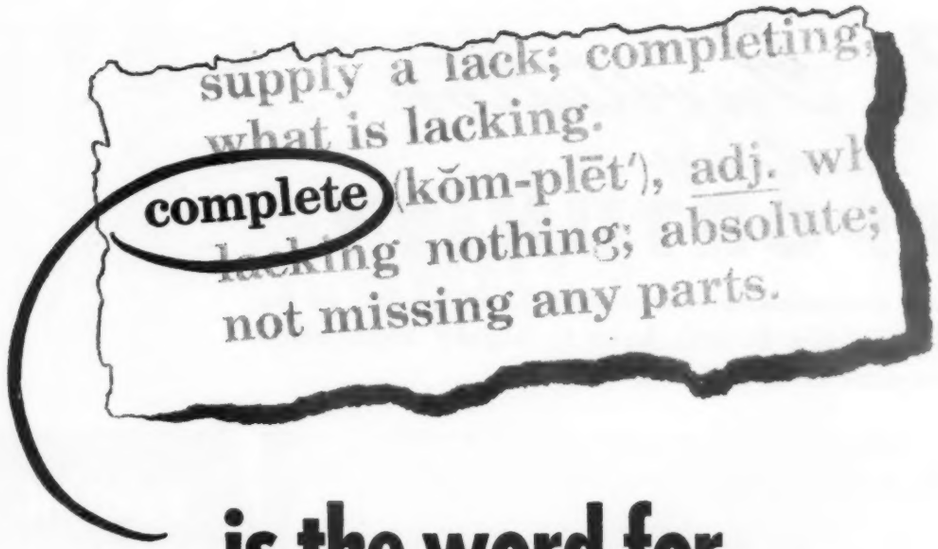

. . . is the word for Ethyl antiknock service

There's nothing halfway about Ethyl antiknock service to refiners.

Throughout twenty-seven years we have been developing a complete antiknock service program designed to assist refiners in attaining the greatest benefit from each cubic centimeter of "Ethyl" antiknock fluid.

The basic idea behind Ethyl antiknock service is to make the octane numbers secured through the use of "Ethyl" fluid the most economical and satisfactory octane numbers the refiner can buy.

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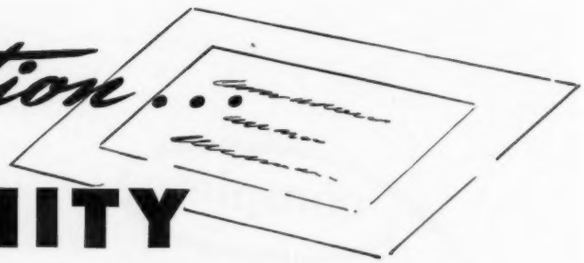
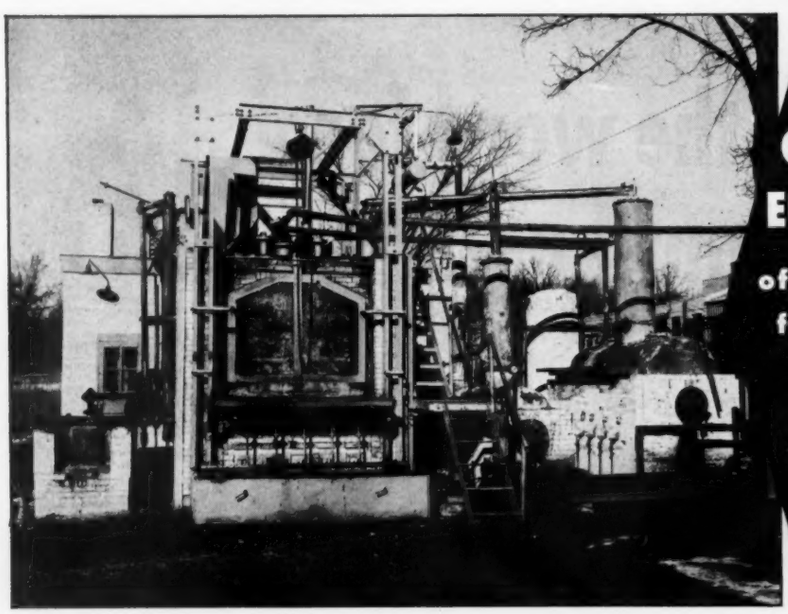
Products sold under the "ETHYL" trade-mark: antiknock compounds . . . salt cake . . . ethylene dichloride . . . sodium (metallic) . . . chlorine (liquid) . . . oil soluble dye . benzene hexachloride (technical)

An Invitation . . .
and an . . .
OPPORTUNITY



To every organization interested in disposing of its heavy residues in the broad, highly profitable Metallurgical Coke market.



CURRAN CARBONIZING & ENGINEERING CO.

offers the improved facilities of its Liquid Hydro-Carbon Coking plant (pilot) for commercial scale tests of your material.

The Curran Carbonizing Process, a flexible and economical method of high temperature coking, opens the door to the conversion of residuums to high quality METALLURGICAL COKE OR ELECTRODE CARBON.

A test of your material may well prove to be the key to greater profits for you. The assistance of Curran Coking Specialists is at your disposal in solving your coking problem (at actual cost of test to us).

Send Sample Today

(Minimum 3 bbls. requested for preliminary analysis). Larger sample required for full scale, commercial demonstration. Your representatives welcome during the course of the test. Wire, write or phone.

Curran Carbonizing & Engineering Co.

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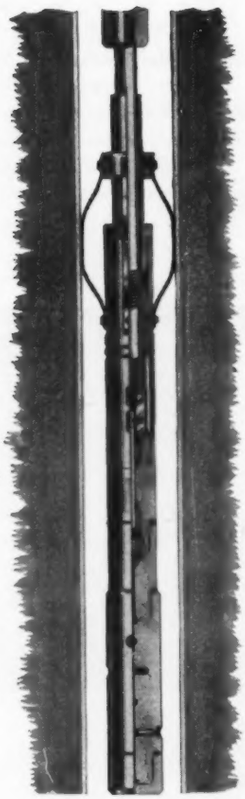
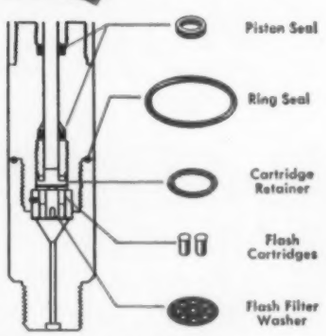


A JOHNSTON SHOOT-N-TEST GUN PERFORATOR

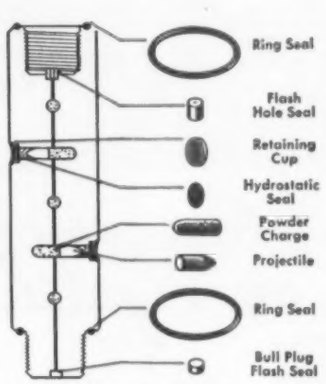
Uses only these few expendable supplies...

THE FEW EXPENDABLE SUPPLIES illustrated are *all* that are needed for each Johnston Gun Perforating Job. After cleaning and drying the Firing Head and Perforating Gun Section, these few parts are easily replaced during normal reassembly. Individual Firing Chambers of each 4, 5 or 6-shot Perforating Gun Section are hand-loaded and need only a light portable hydraulic capper to assure precision alignment of the retaining cups over the firing chambers.

The Firing Head of the Johnston Gun Perforator requires no special tools or fixtures to effect complete reassembly. The Sealing Rings, Piston Seals, Flash Washers and two 32-calibre cartridges are negligible in cost and can be replaced right on the rig floor. Belly Springs need be replaced only when friction-worn beyond their ability to hold tension. Tension can be re-set before each run.



FIRING HEAD EXPENDABLE PARTS



GUN SECTION EXPENDABLE PARTS

Before you purchase any Gun Perforating Equipment check the outstanding advantages offered by the Johnston All Purpose Gun Perforator!

PERFORATE AND TEST IN ONE TRIP! To *both* perforate casing and test formation in one trip of tubing or drill string you simply connect the Johnston "SHOOT-N-TEST" Gun Perforator to your regular Johnston Tester and Pressure Recorder. First you fire the Gun Perforator and then take a formation sample immediately after perforating casing.

SAFE GUN PERFORATOR OPERATION! The Johnston Gun Perforator affords utmost safety in all phases of gun perforator operation. It will not fire until subjected to both in-the-hole hydrostatic pressure and top-hole manipulation by the driller.

PORTABILITY AND FLEXIBILITY! The Johnston Gun Perforator can be transported in the back of your regular field car! And after arriving at well location, you attach only the number of 4, 5 or 6-shot Perforating Gun Sections needed for that particular job.

EXACT POSITIONING IN PRODUCING ZONE! Accurate placement of the Johnston Gun Perforator opposite the zone selected for perforating is easily determined by your own pipe-in-the-hole tally. No rigging up of special measuring devices is necessary.

POSITIVE FIRE OF ALL PROJECTILES! The safe, fool-proof hydrostatic firing principle of the Johnston Gun Perforator Firing Head coupled with the flash-hole design of the Perforating Gun Sections insures positive fire of all projectiles.

***Write** For New Descriptive Folder!*

SHOOT-N-TEST Trademark FORMATION AND CASING TESTING

M. O. JOHNSTON OIL FIELD EXPORT CORPORATION

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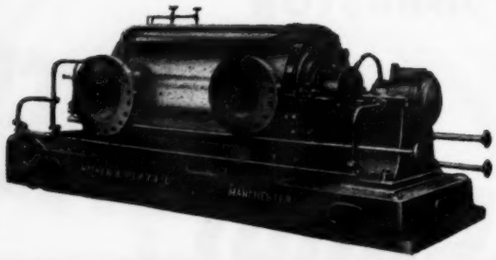
Centrifugal Pumps
& FLAMEPROOF MOTORS

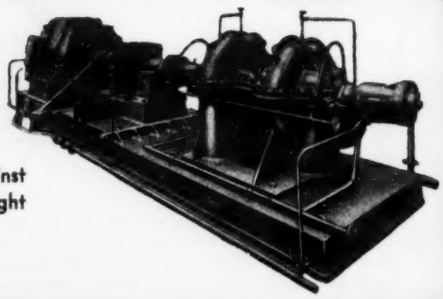
Main Pipeline Pumps....



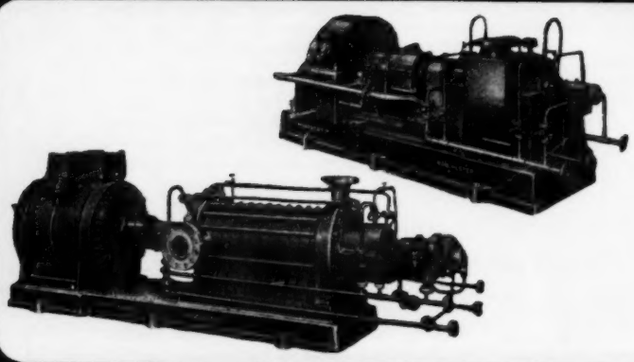
Mather & Platt multi-stage 'Plurovane' pumps were amongst the earliest centrifugal pumps installed for main line work. The pump shown on the left is a typical modern 'Plurovane' designed for a throughput of 50,000 bbls/day of crude oil against a pressure of 750 p.s.i. when running at 1500 r.p.m.

Transfer and Loading Pumps

Our standard ranges include a pump for nearly every transfer or loading duty. The two-stage "Medivane" pump illustrated on the right can handle 700 tons/hr. of crude or products against heads up to 500 ft. It is driven through a gas tight wallbox by a 550 h.p. Mather & Platt Motor.



Refinery Process Pumps



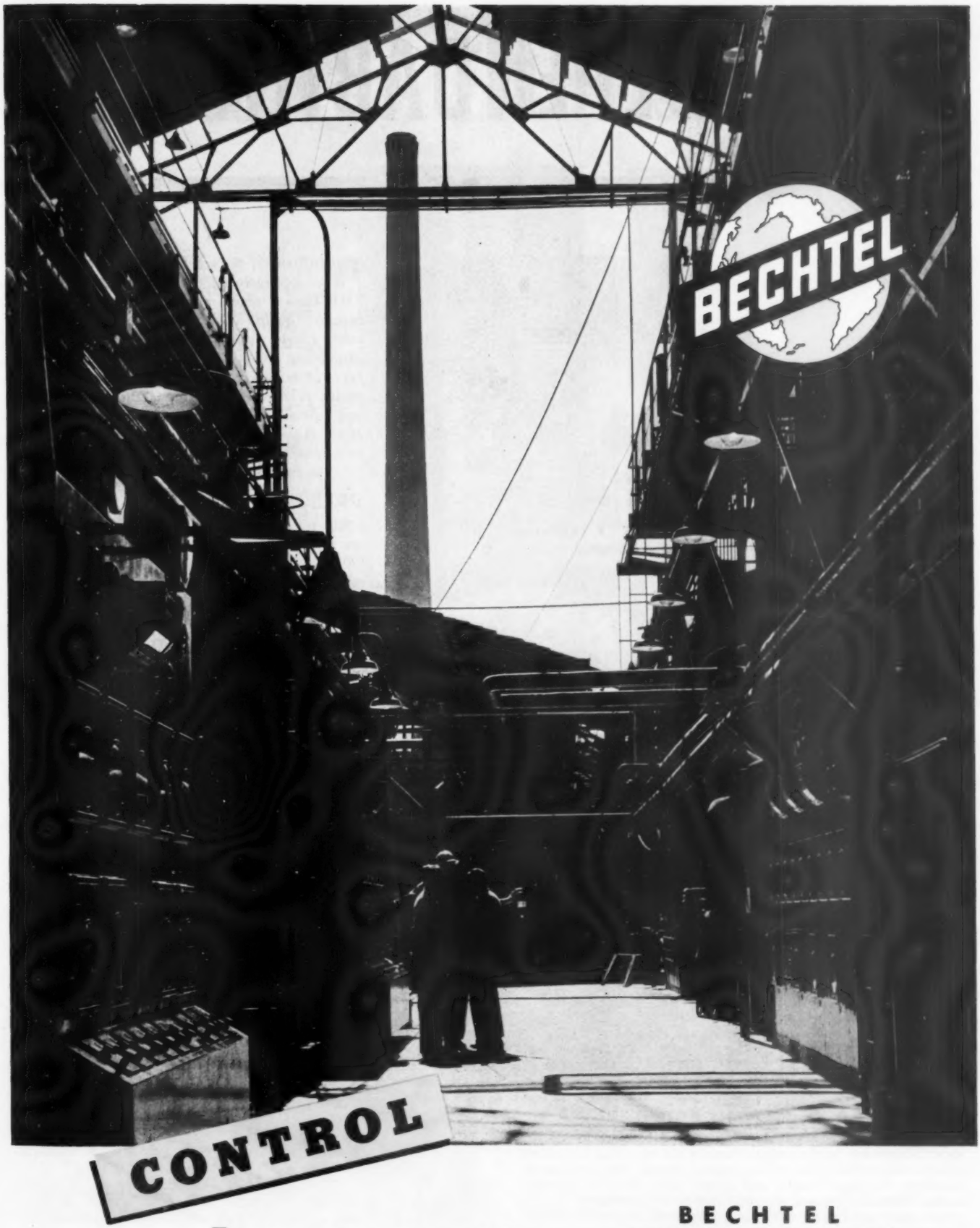
Our long refinery experience at home and abroad enables us to supply pumps for the most arduous refinery duties. The illustration shows typical units:—a steam turbine driven pump handling oil at 500 degs. F. and a motor driven "Plurovane" pump dealing with light volatile hydrocarbons.

Flameproof Motors on Pipeline Duty....

Mather & Platt electrically-driven centrifugal pumps on an oil pipe line. The motors here illustrated are of the totally enclosed flameproof type, and are of 1,000 h.p. capacity, fed from a 3 phase 50 cycle 6000/6600 volt supply. They are squirrel cage direct-on started machines with a starting current of four times full load value.

MATHER & PLATT
LIMITED

PARK WORKS · MANCHESTER, 10 · ENGLAND



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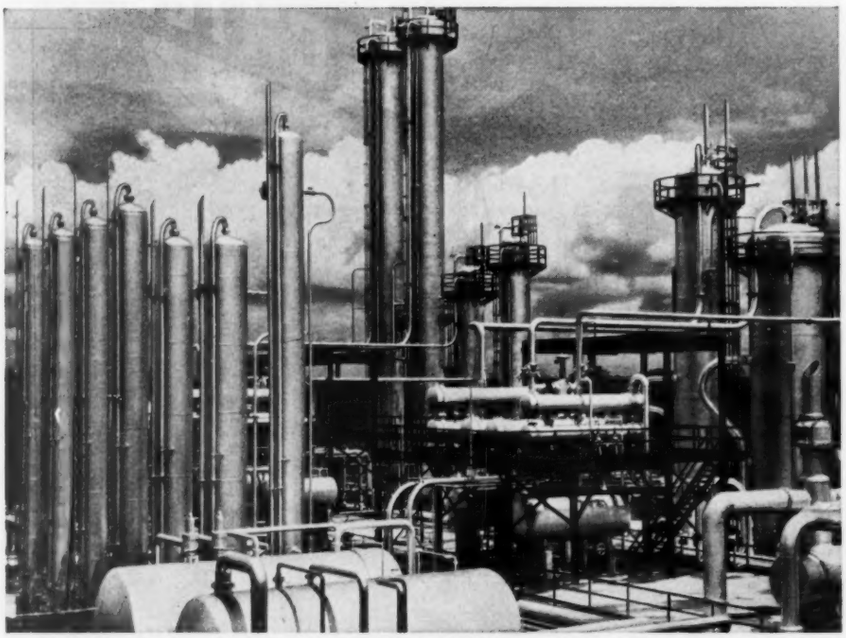
DESIGN • ENGINEERING • CONSTRUCTION

DEPENDABILITY *through*

A.O. SMITH Smith way

TRADE MARK REG U. S. PAT OFF



THROUGHOUT the world, in every field of petroleum operations, the round "A. O. Smith—SMITH*way*" trade-mark identifies products of superior quality . . . products that spell greater safety and less cost all the way from well to retail dispensing pump. The full sum of A. O. Smith's 76 years of research, engineering, manufacturing experience, and manufacturing facilities is available to you. Address the International Division, P.O. Box 2023, Milwaukee 1, Wis., U.S.A., or mail coupon on opposite page.

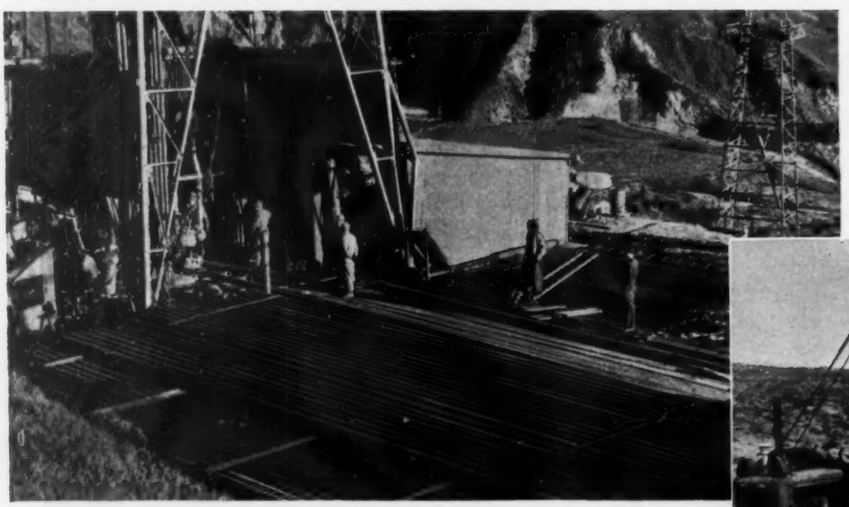
PRESSURE VESSELS

SOLID-WALL vessels, custom-built to your specifications, are manufactured by A. O. Smith in a virtually unlimited range of sizes, wall thicknesses, and types.

MULTI-LAYER vessels are custom-built with wall thicknesses up to 8⅝ inches, for pressures as high as 10,000 psi.

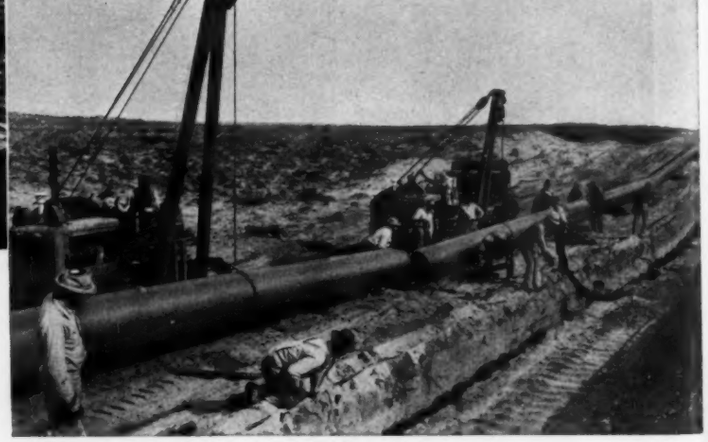
LININGS for corrosion-resistance can be supplied for service where conditions require it.

It will pay you to consult with A. O. Smith first on your vessel problems.



A. O. SMITH LINE PIPE

For economical transportation of oil, gas, and gasoline. Superior strength combined with less weight, plus dependable uniformity, has given A. O. Smith Large-Diameter Welded Line Pipe acceptance with major pipe-line companies the world over. Outside diameters from 10¾ inches to 30 inches.



A. O. SMITH CASING

Lower per-foot cost—lower shipping costs. All-welded for greater yield strength and lighter weight. Permits lighter casing for specific depths without safety-factor loss; greater depths with equal safety factor for the same weight, and higher safety factor at specified depths without increased weight. Uniform 50-ft. lengths, 7 in. to 13⅜ in. diameter. Higher minimum collapse resistance—longer life.

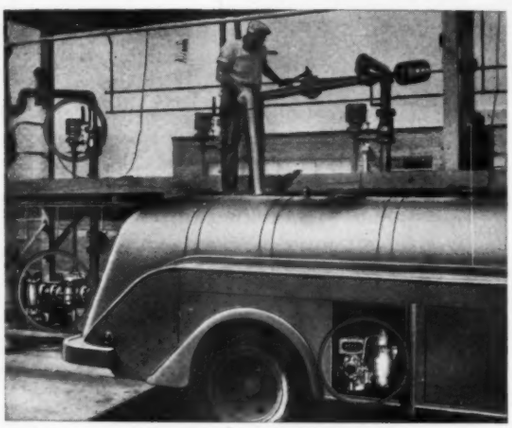
OTHER A. O. SMITH PRODUCTS

ELECTRIC MOTORS • GLASS-LINED TANKS • AUTOMATIC WATER HEATERS, GAS AND ELECTRIC
HEAT EXCHANGERS • PENSTOCKS • HEATING BOILERS, GAS-FIRED
SAFETY GRATING • HARVESTORES FOR FARM FEED CROPS

RESEARCH *and* ENGINEERING

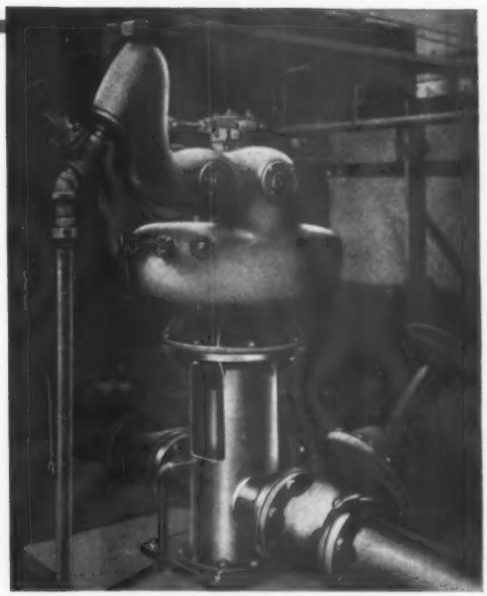
PETROLEUM METERS
and Liquid Level Gages

World-famous for sustained accuracy, minimum pressure-drop, rugged construction. Rotary, positive-displacement meters, 15 to 650 U.S.G.P.M., for loading racks, pipe lines, tank trucks. Registration in U.S. gal., Imperial gal., liters, dekaliters, barrels. LIQUID LEVEL GAGES for tanks of all shapes and sizes—direct and remote registration. Complete line of accessories.



DISPENSING PUMPS

For gasoline—electrically operated computing type. This pump combines beauty of appearance with accuracy and exceptional dependability. Available in both high and low models.



TURBINE PUMPS For charging fractionating towers, pipe-line boosting, moving oil in refinery, cooling towers, fresh-water supply, other pumping. Standard and custom-built. Electric, engine, or steam-turbine drives. Minimum floor space. All parts designed and built together, to work as a unit. Users acclaim lowered maintenance costs.

WELDING EQUIPMENT

A COMPLETE LINE OF WELDERS

AC transformer type; AC motor-driven; AC and DC Welders; gasoline-engine driven AC and DC Welders; AC and DC welding generators only; complete shop and field trailers and accessories. Ranges from 200 to 500 amperes. Electrical characteristics to meet your requirements.

CERTIFIED ELECTRODES

Mild, high-tensile, stainless, and hard-surfacing steel types. A. O. Smith Electrodes take the risks out of welding, and make it the modern, economical tool for all kinds of jobs in the petroleum industry. Better welds at lower cost.

LIQUID GAS SYSTEMS

For all types of liquefied fuel gas—butane, propane, anhydrous ammonia. Above-ground Systems, equipped with the exclusive Vapor Dome (all fittings grouped in one easy-to-reach spot), with capacities from 250 to 2500 U.S. gal. Underground Systems, 250 to 1000 U.S. gal. For residence, commercial, and industrial installations where liquefied gas is used for heat or power. Made to the same superior standards that distinguish all A. O. Smith Products.

A.O. SMITH Smith way — 76th ANNIVERSARY 1874 - 1950

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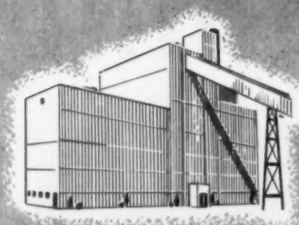
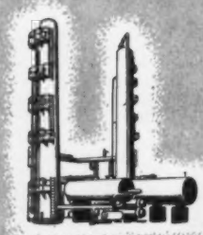
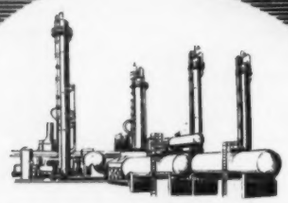


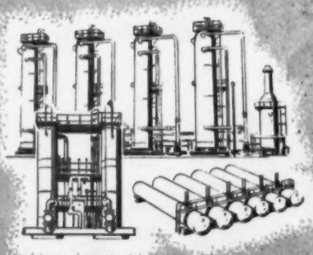
POWER DIVISION



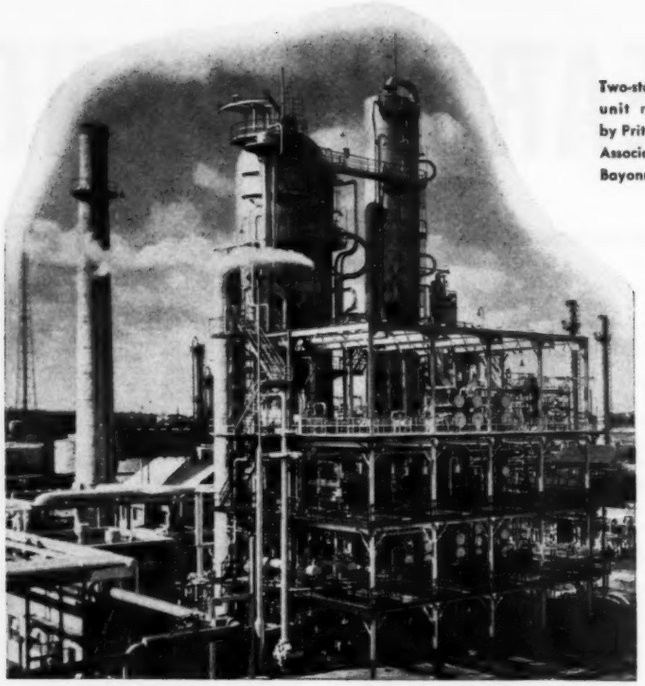
CHEMICAL DIVISION



PETROLEUM DIVISION



NATURAL GAS DIVISION



Two-stage crude distillation unit recently completed by Pritchard for Tide Water Associated Oil Company at Bayonne, New Jersey.

Pritchard Designs for Versatility and Accessibility

This unit is typical of Pritchard's forward looking ingenuity in Design, Engineering and Construction. Designed to the customer's requirements for replacement of an existing crude unit and for processing six different types of crude oil at a nominal capacity of 22,500 bbls. day, this unit simultaneously produces eight different distillate fractions ranging from light gasoline to cylinder stock!

At the same time particular care was taken to design the unit for maximum accessibility to the heat exchanger equipment, thus facilitating handling and reducing "shut down" time and maintenance costs.

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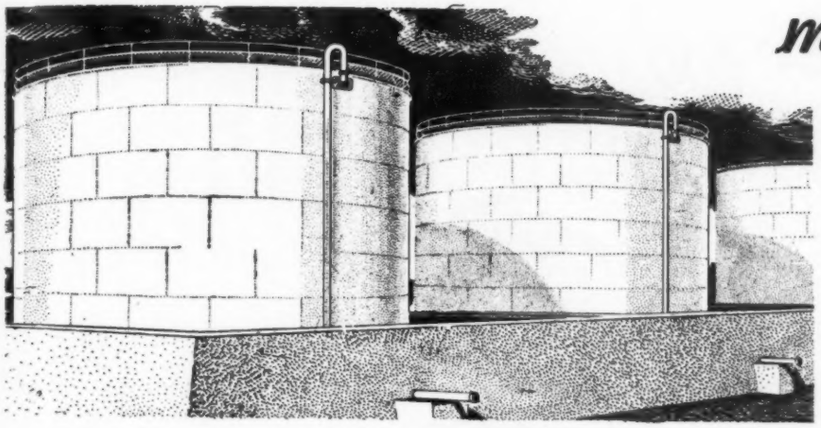
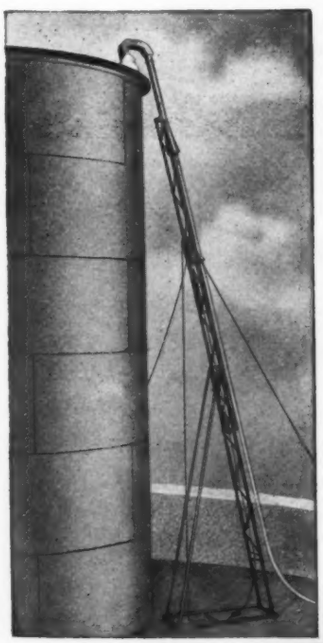


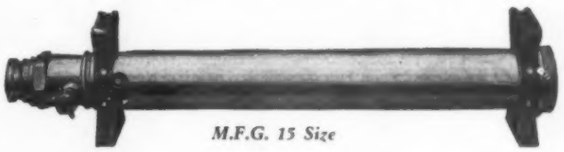
FIXED FOAM INSTALLATIONS. Many years of experience and research have been given to the application of "Pyrene" Mechanical Foam to oil storage tank fires. It will pay you therefore to consult us for details of special equipment for this purpose, and advice on the best methods of overcoming fire dangers of this kind.

TELESCOPIC FOAM TOWERS

This portable equipment is made in several models for use on floating roof tanks or where foam can be applied through manhole covers or fractured roof plates. The type illustrated is easily manœuvred and erected by four men, and it is mounted on a two-wheeled chassis for easy transportation. These towers are made for use with either fixed No. 20 size Foam-making Branchpipes or for use with "Pyrene" Mechanical Foam Generators.

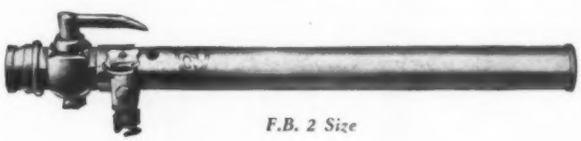


MECHANICAL FOAM GENERATORS. The range of "Pyrene" Mechanical Foam Generators produces fire-fighting foam of exceptionally high quality in great volume and at a high speed of delivery. They have the great advantage that they can pass foam through piped circuits, ordinary canvas fire hose or vertical pipelines and may be operated in a position remote from the fire, if desired. Available in a range of sizes producing up to 2,400 gallons of foam per minute.



M.F.G. 15 Size

FOAM-MAKING BRANCH PIPES. These Mechanical Foam Appliances are extensively used by Fire Brigades, Oil Companies and other industrial concerns. They produce foam at the end of the water line. The F.B.2. Model shown is a portable unit made in light alloy and is generally used in conjunction with a foam compound knapsack tank of 4 gallons capacity. It operates on a water pressure as low as 60 lbs. per sq. inch and gives a foam output of 450 g.p.m. In a range of sizes producing from 96 to 2,400 gallons of foam per minute.



F.B. 2 Size

"PYRENE" FOAM TENDERS such as that illustrated below are specially equipped with "Pyrene" fire-fighting apparatus for dealing with oil fires. This model is fitted with two M.F.G.15 "Pyrene" Mechanical Foam Generators, each producing 1,250 gallons of foam per minute, a tank carrying 500 gallons of "Pyrene" Foam-making Compound and six 50 lb. CO_2 gas cylinders with two hose reels and distributor horns. The fire pump is of 350/500 g.p.m. capacity.

Pyrene TRADE MARK FIRE APPLIANCES

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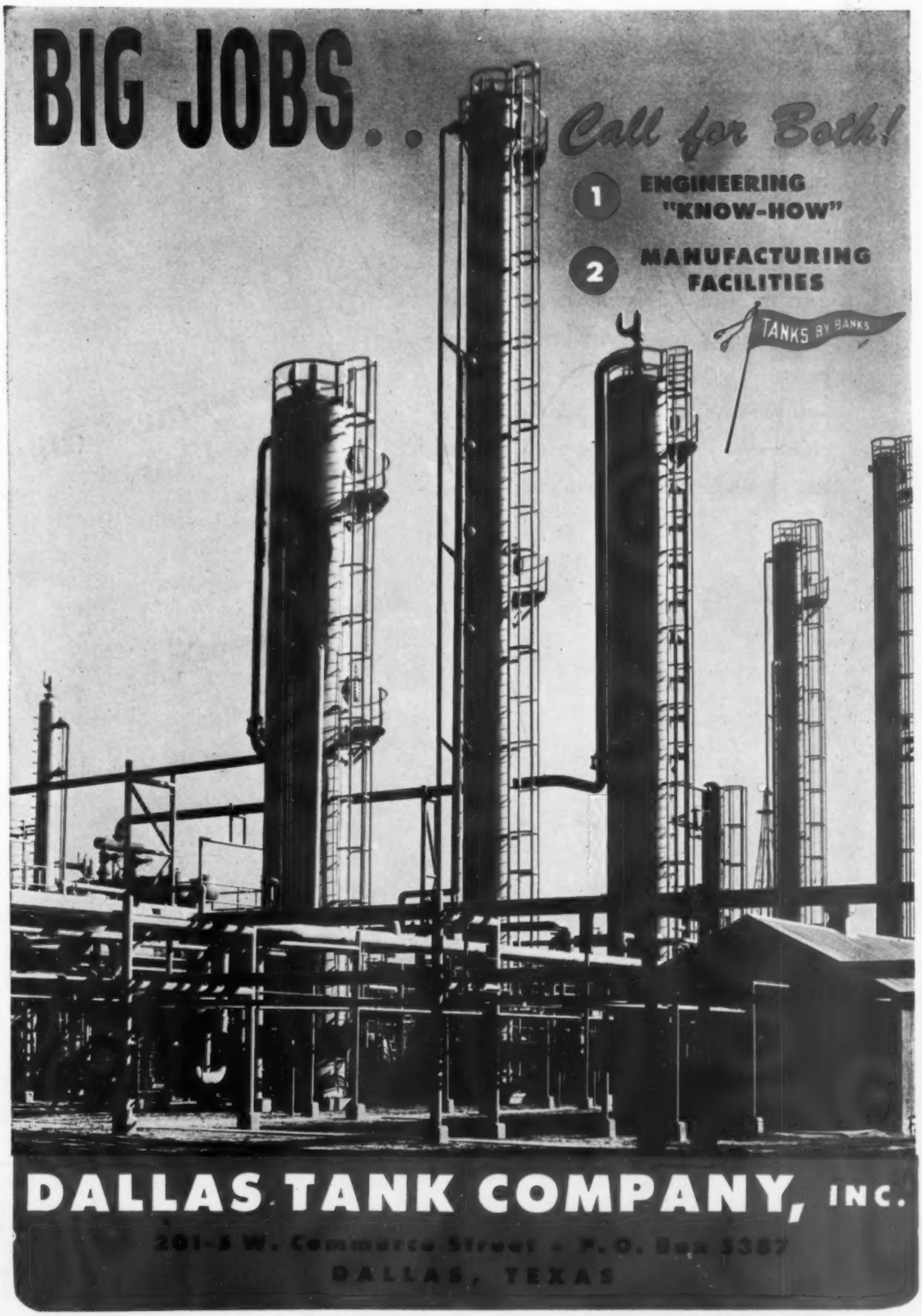
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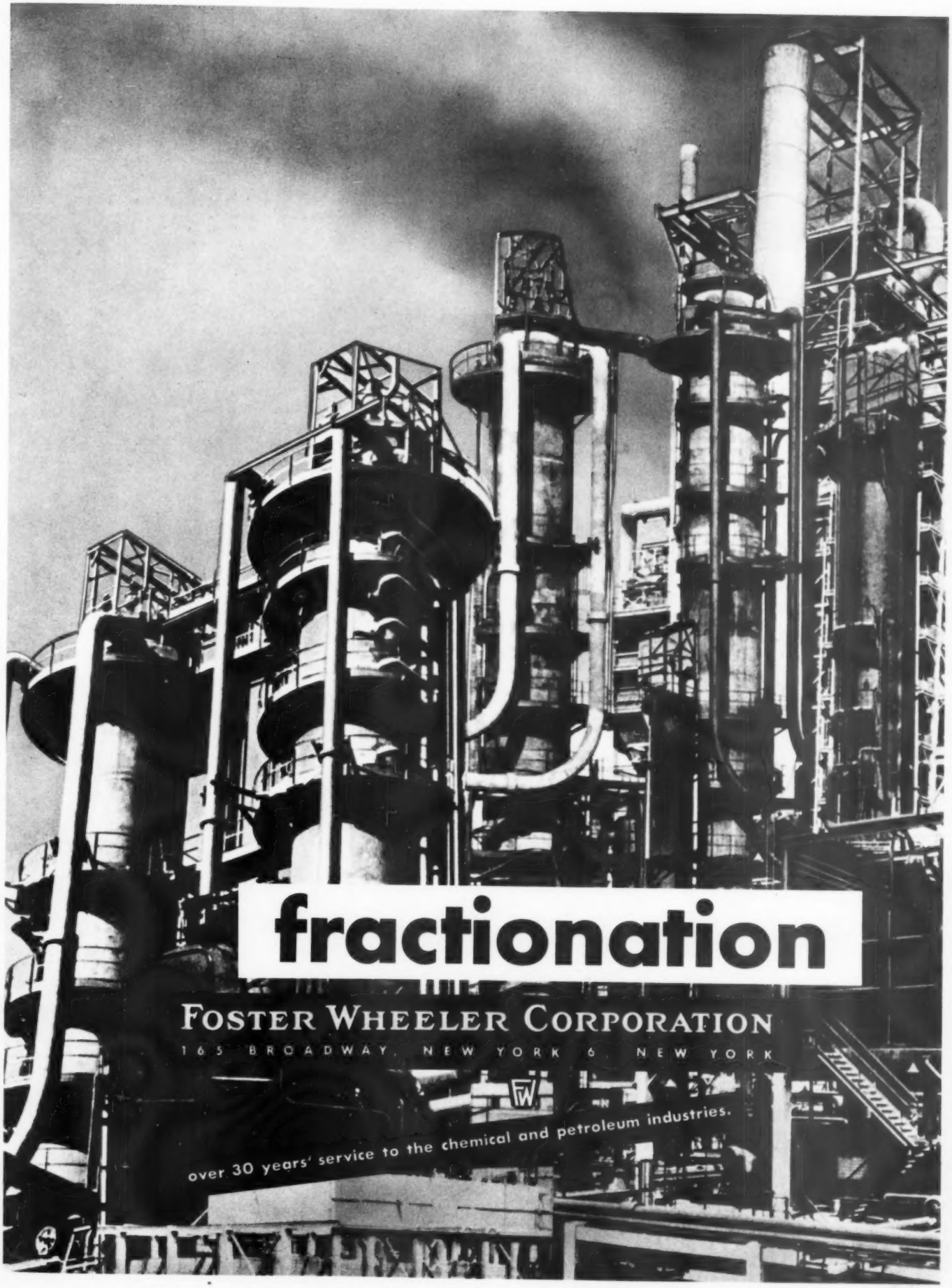
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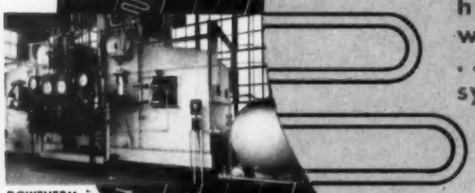

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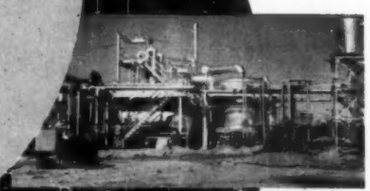

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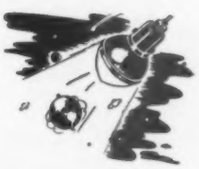

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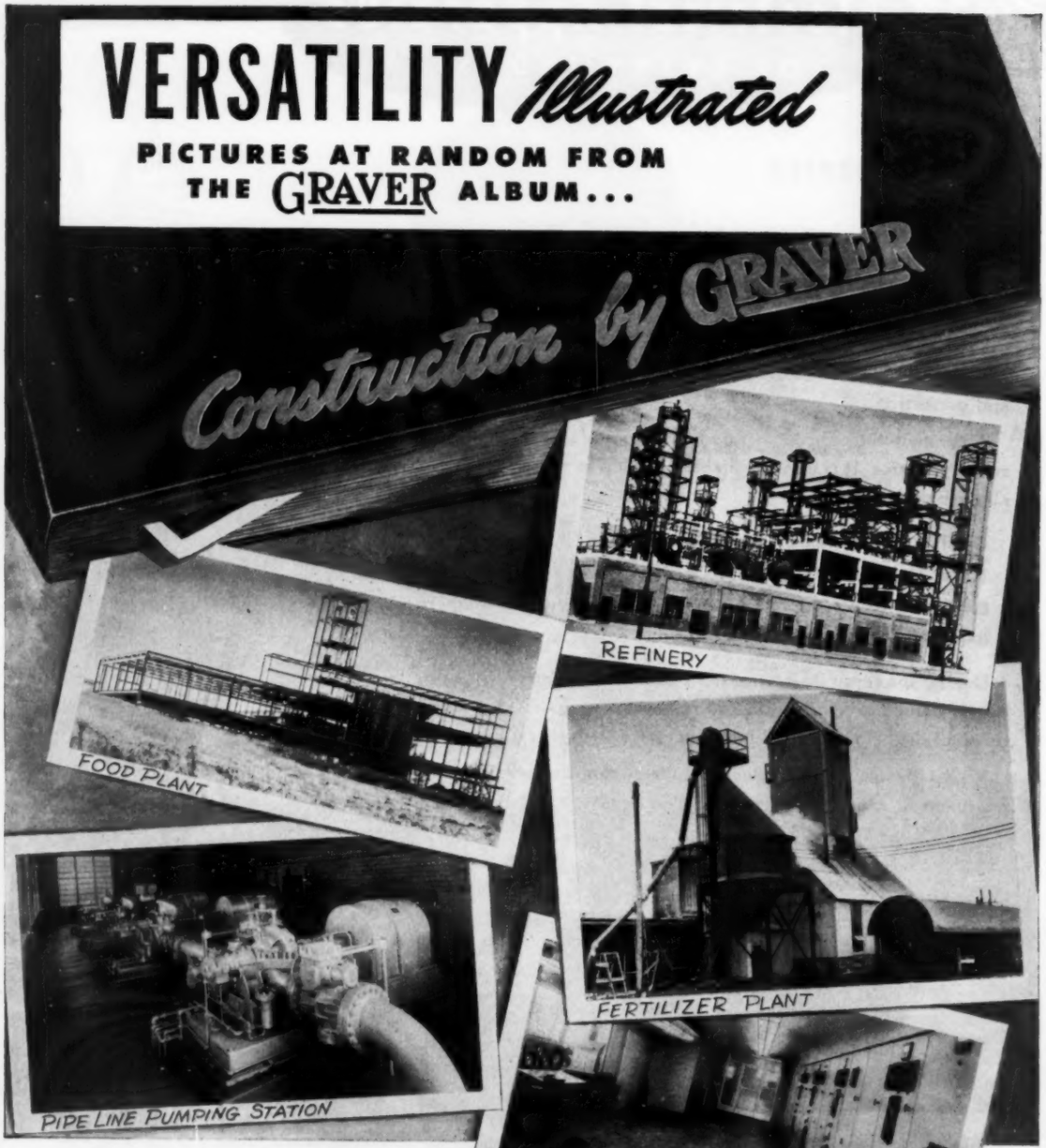

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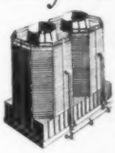

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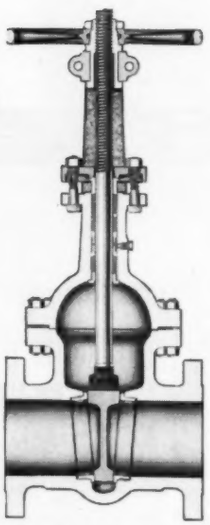

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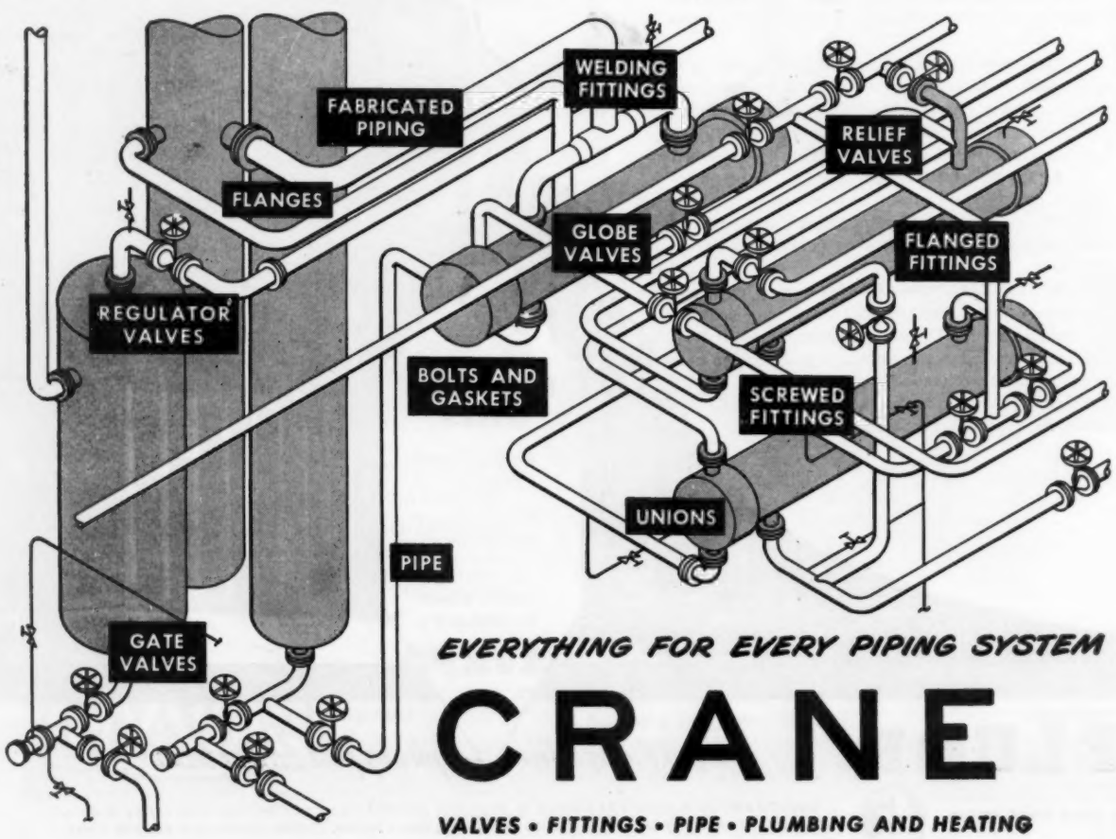

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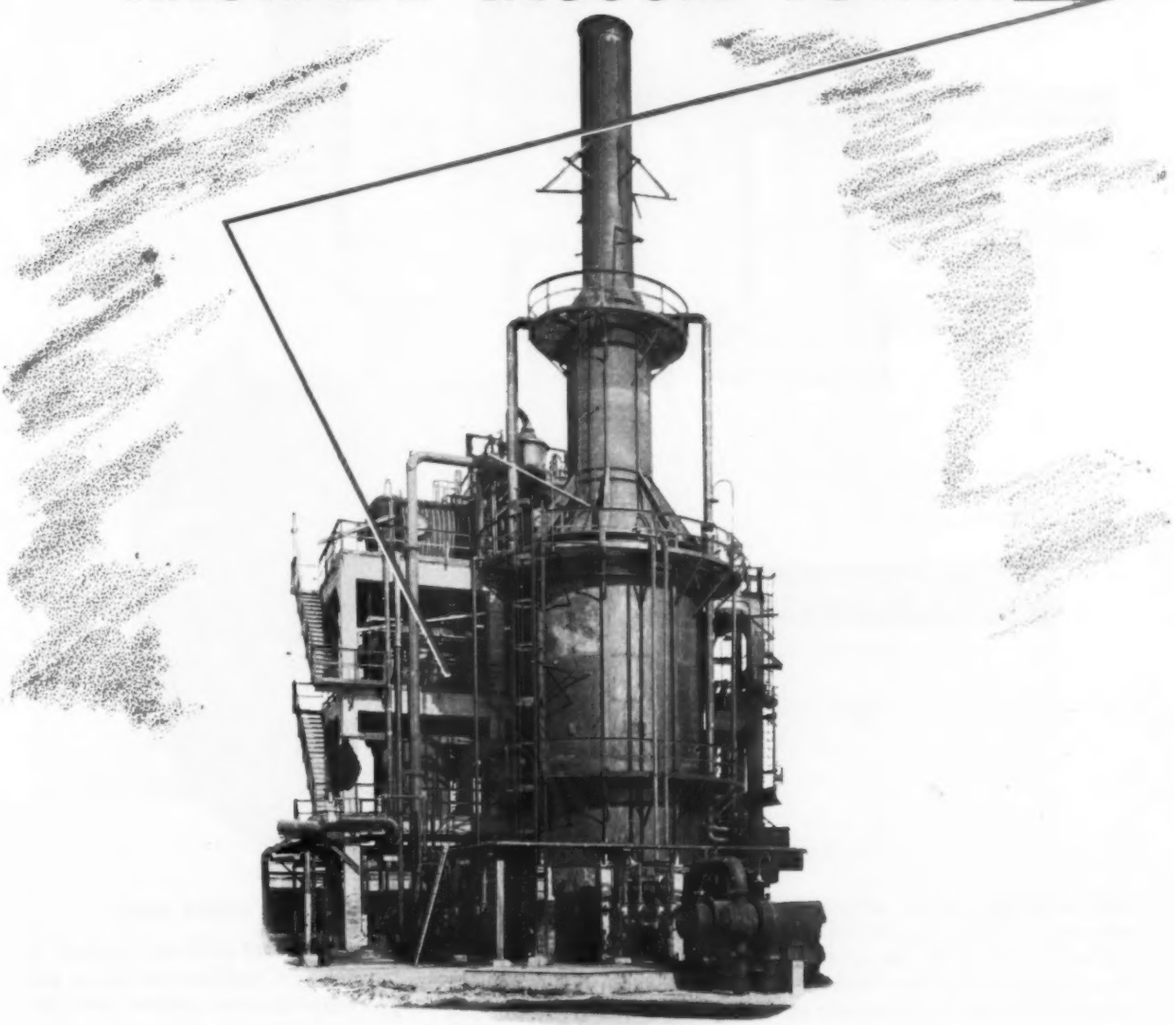

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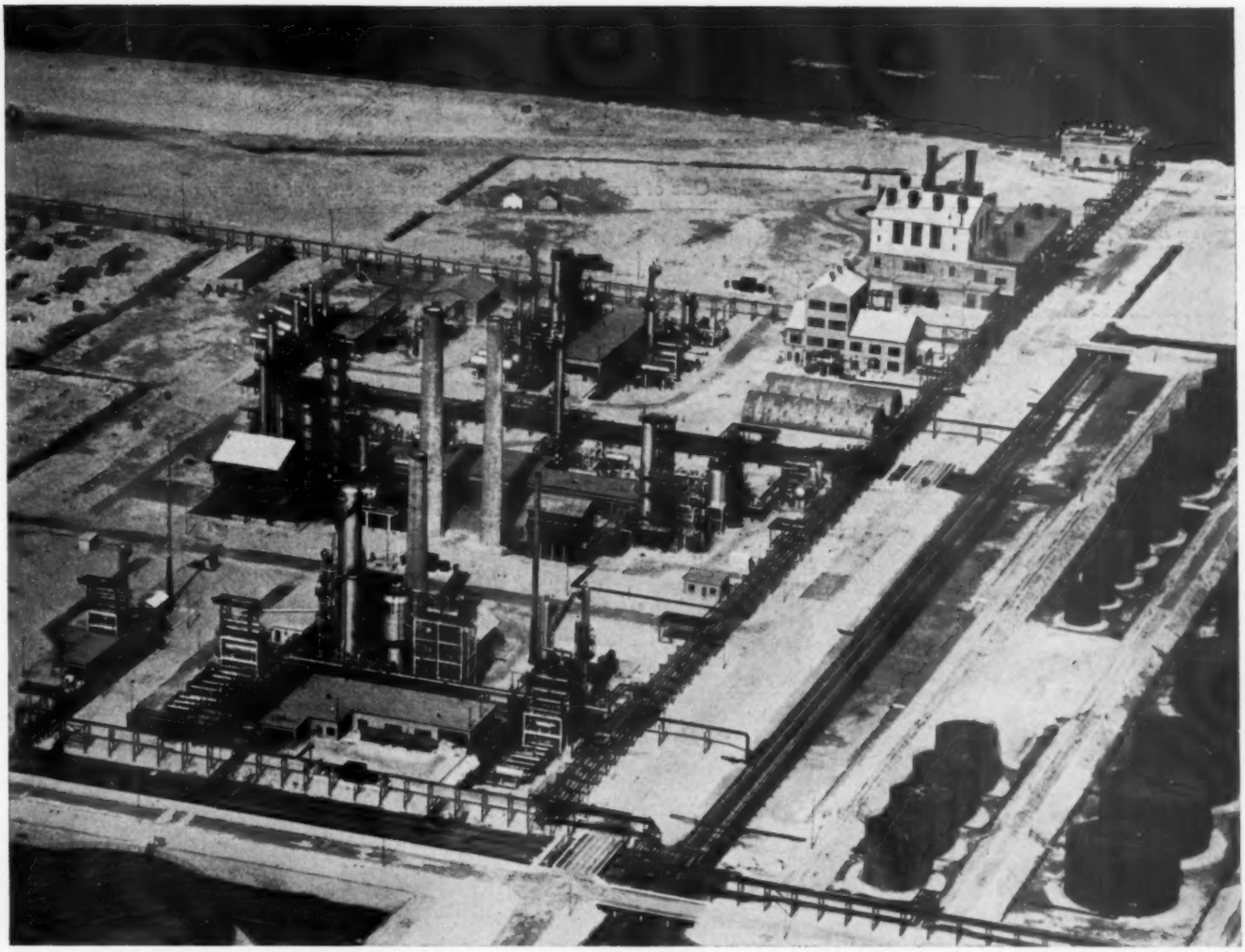

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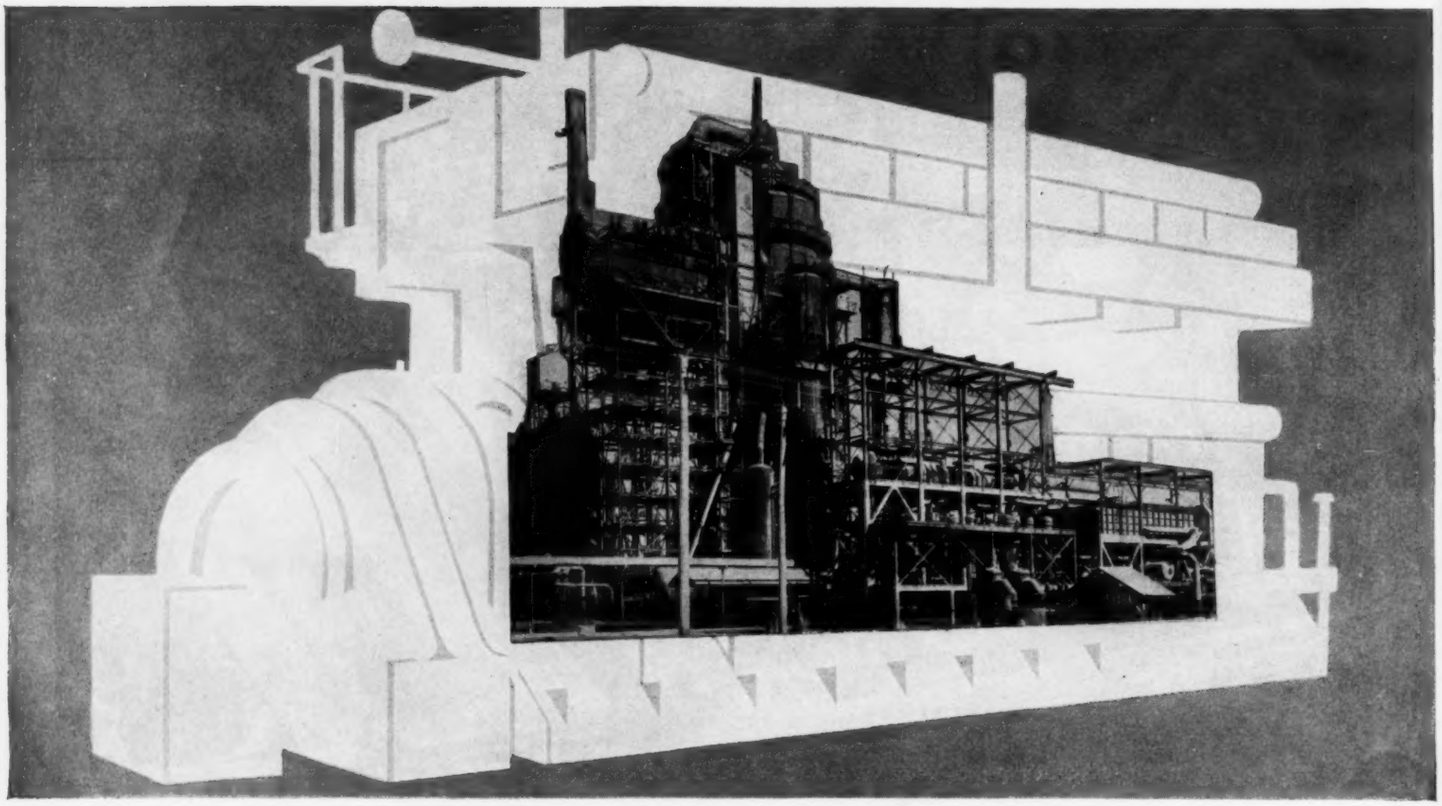

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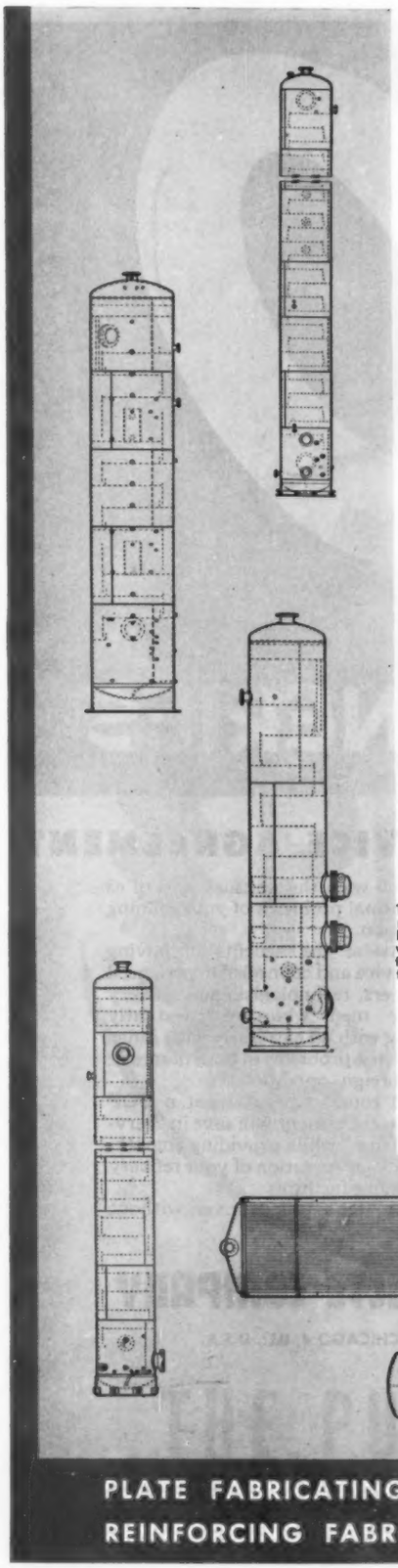

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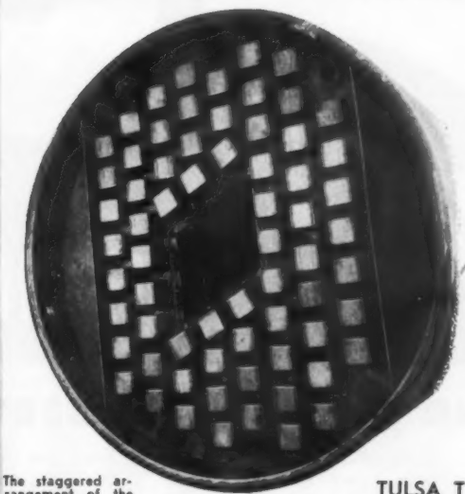

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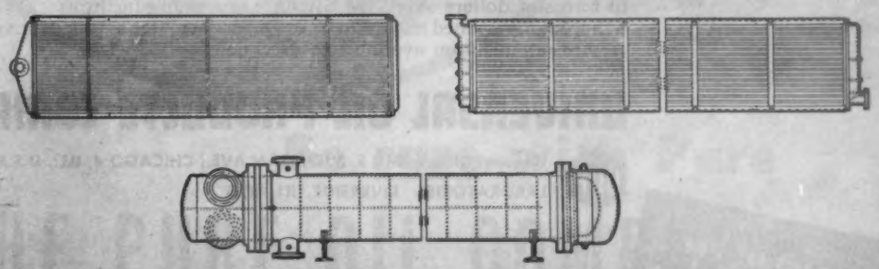

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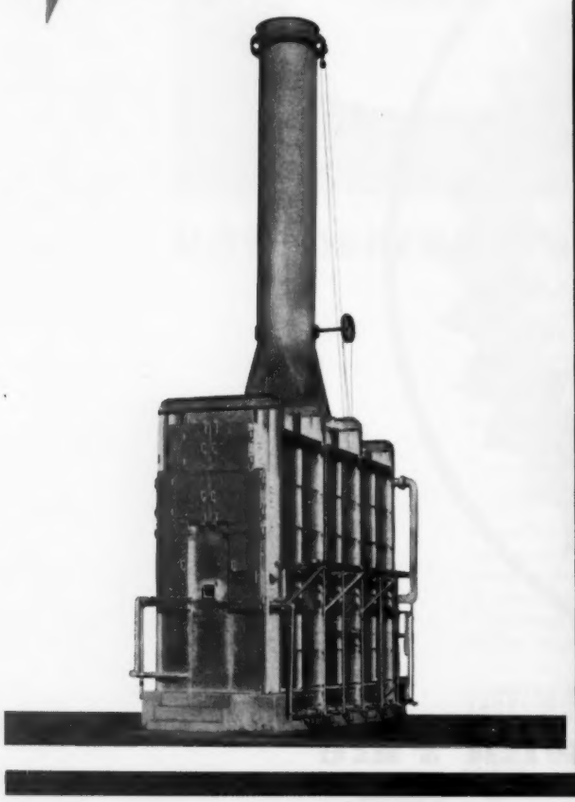

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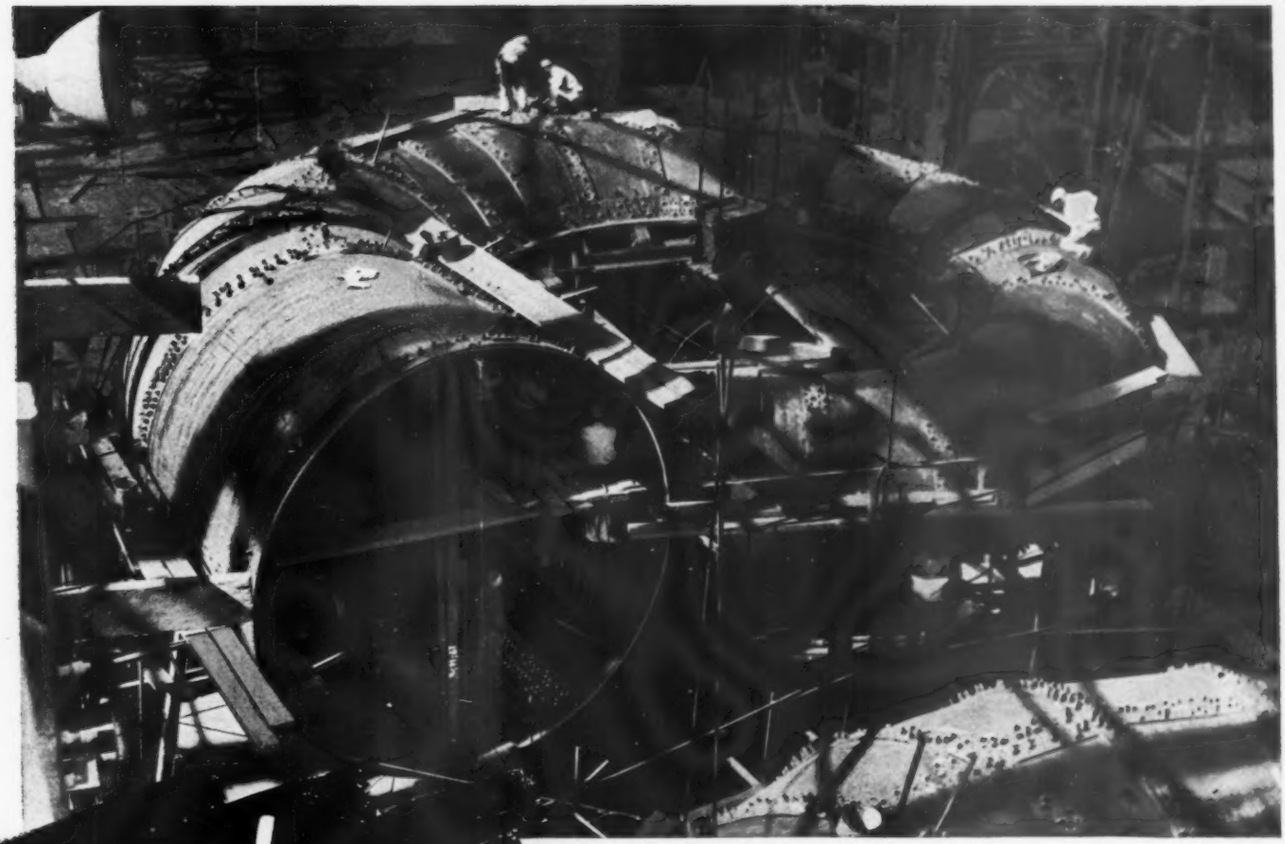

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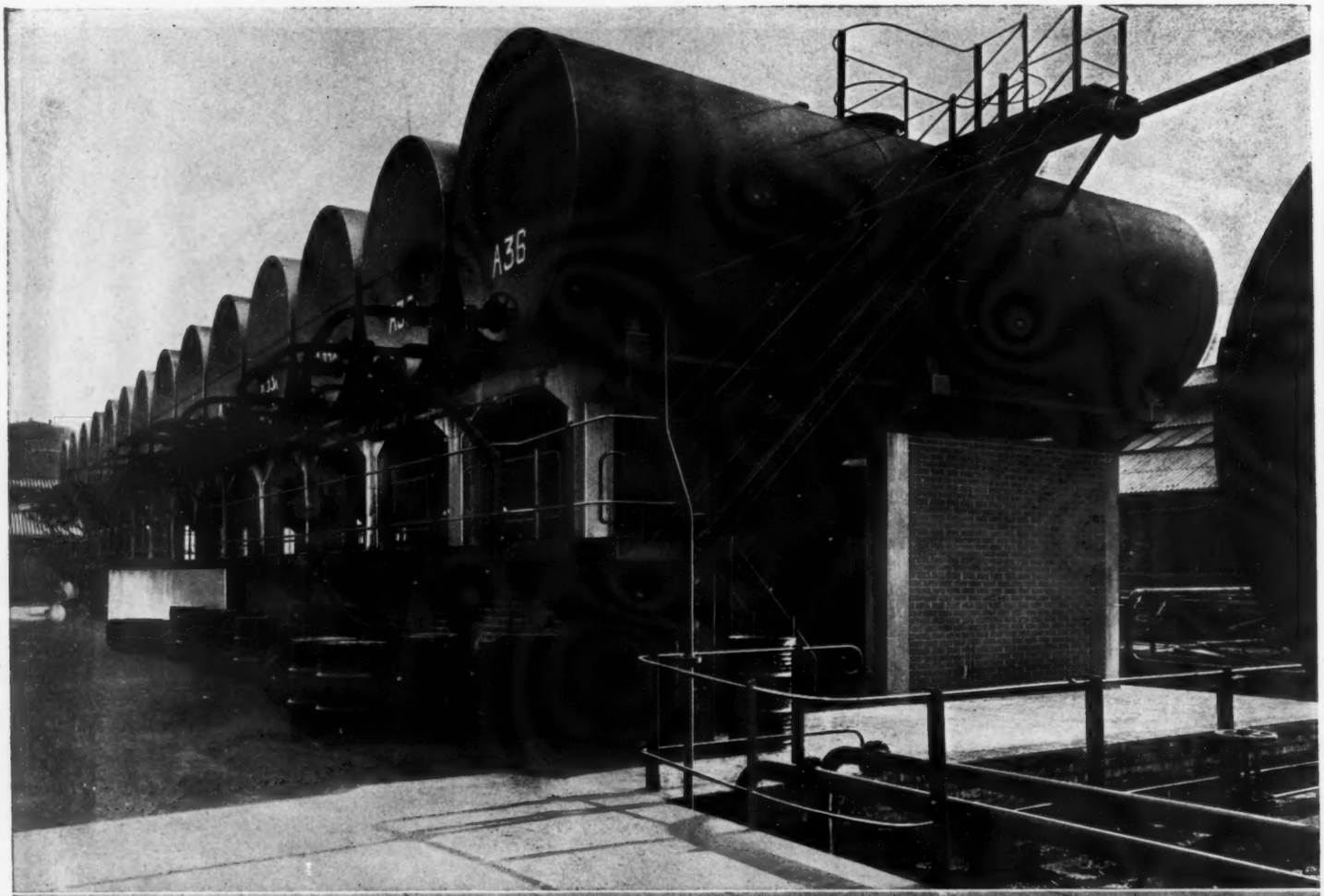

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WELDED STORAGE TANKS

A close-up view of a battery of fourteen welded storage tanks each 9′0″ diameter by 30′0″ long with connecting platforms and access staircases. Erected and installed by Oxley at Ellesmere Port, Cheshire, England, for Lobitos Oilfields Ltd., who gave permission for this photograph to be taken.

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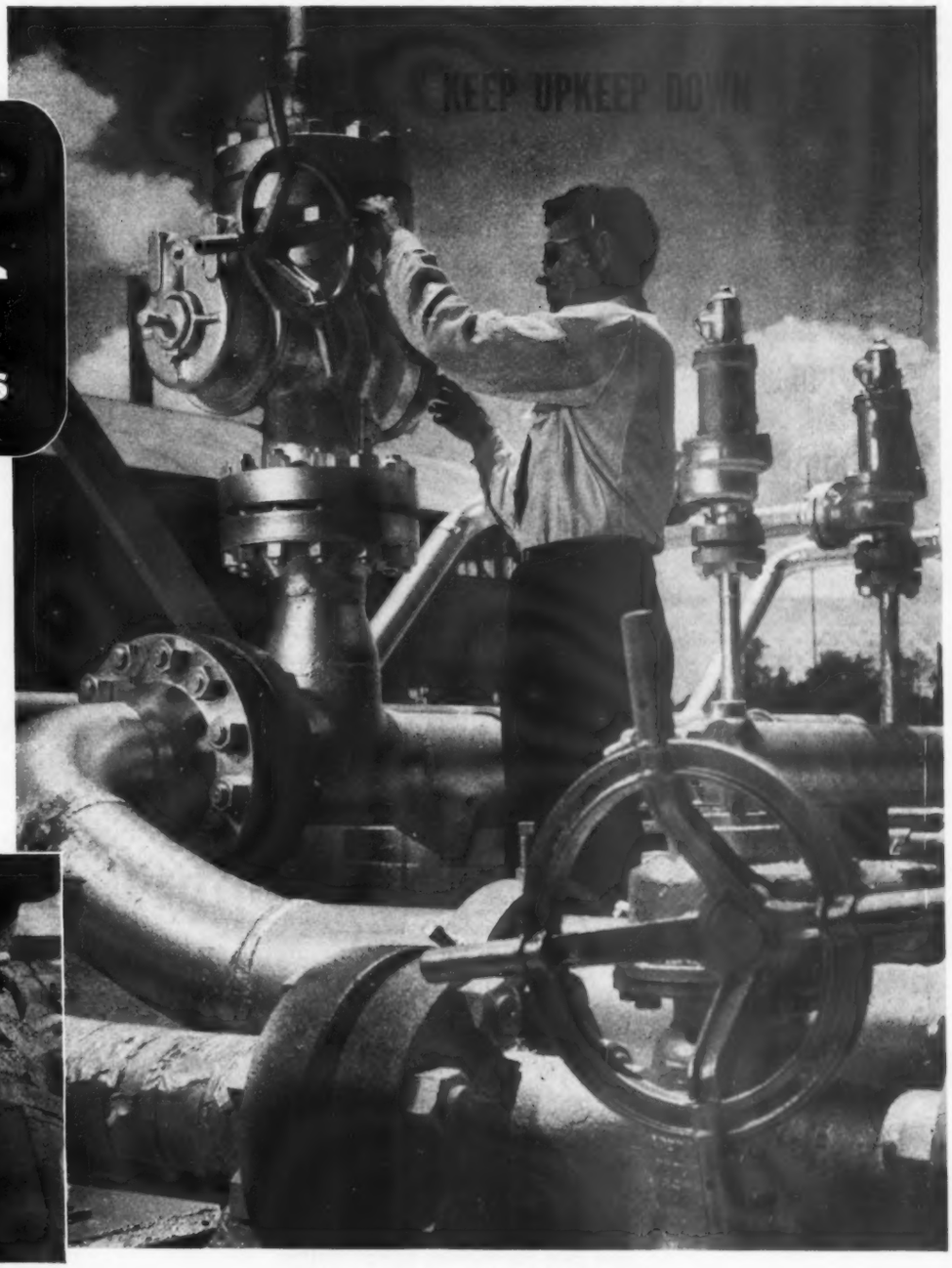

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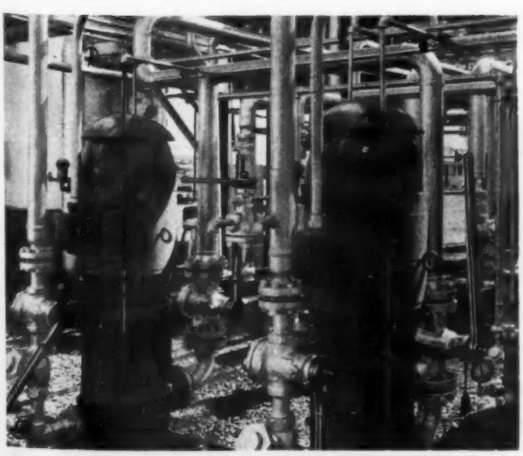

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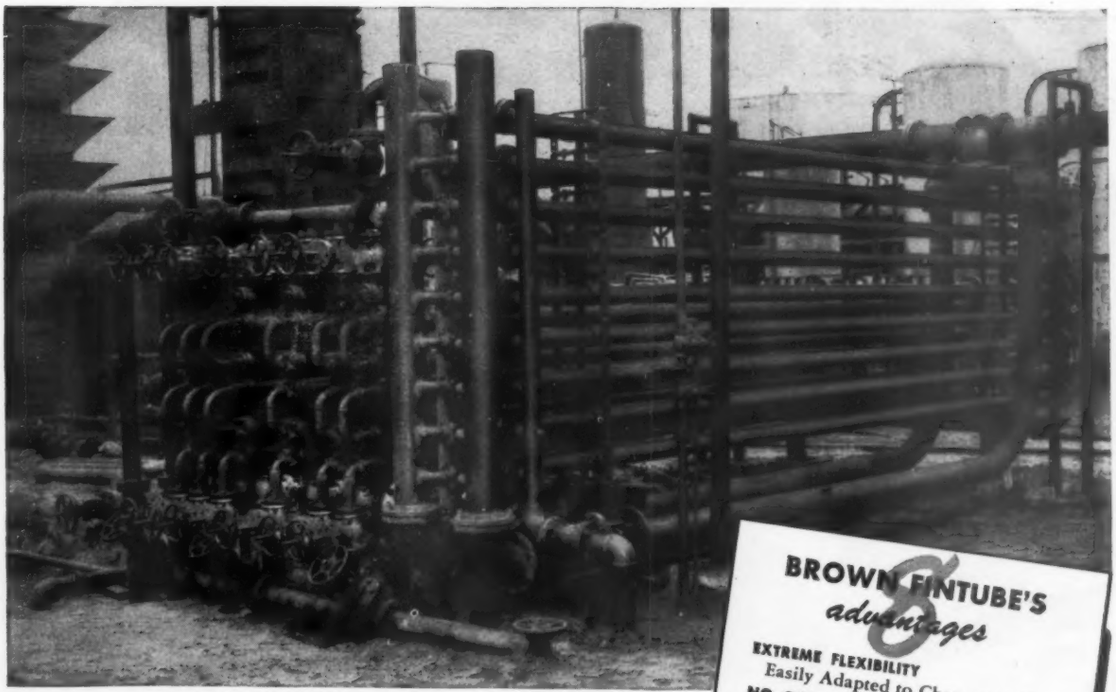

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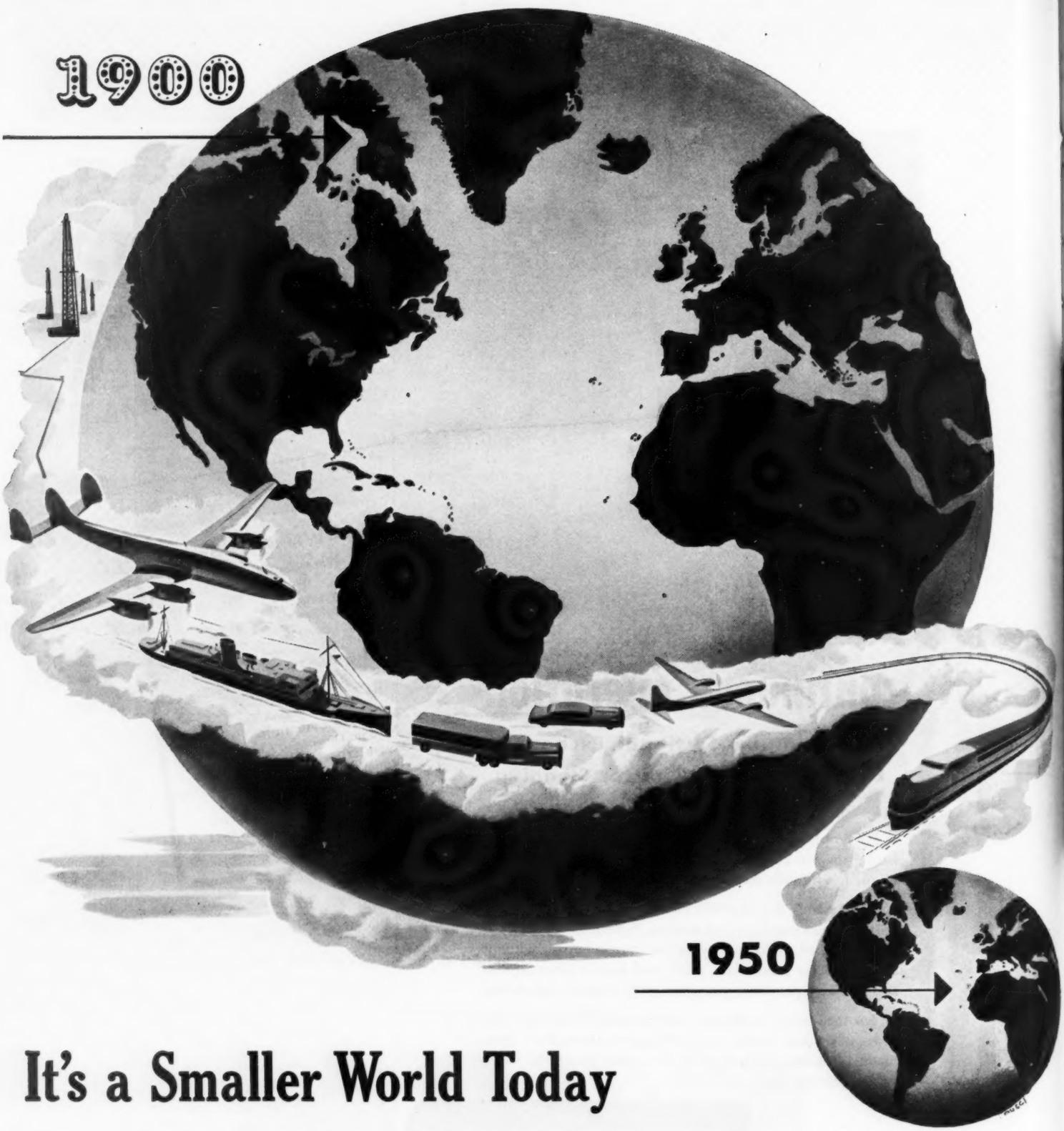

It's a Smaller World Today

Fifty years ago it took over two months to go around the world by the fastest means available. But recently a journalist made the trip in nine days, with time for 400 interviews en route! This shows how the world has grown steadily smaller as transportation by land, sea and air has progressed. Peoples far removed from each other are more easily able to visit back and forth—to exchange goods and services. No longer are the oceans barriers between continents.

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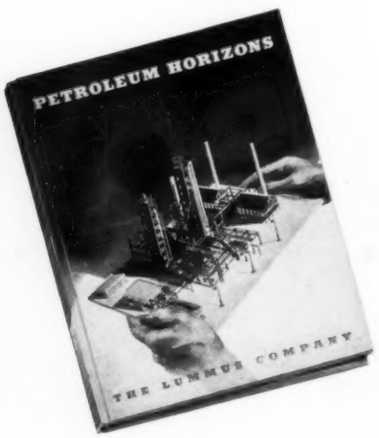

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The Management Publication of the International Petroleum Industry

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Annual subscription $5.00 (U. S.) postpaid
Single copies 50 cents

GENERAL OFFICES

2 West 45th Street, New York 19
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BRANCH OFFICES

LONDON
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World Petroleum is published by Mona Palmer, Trustee under the will of Russell Palmer.

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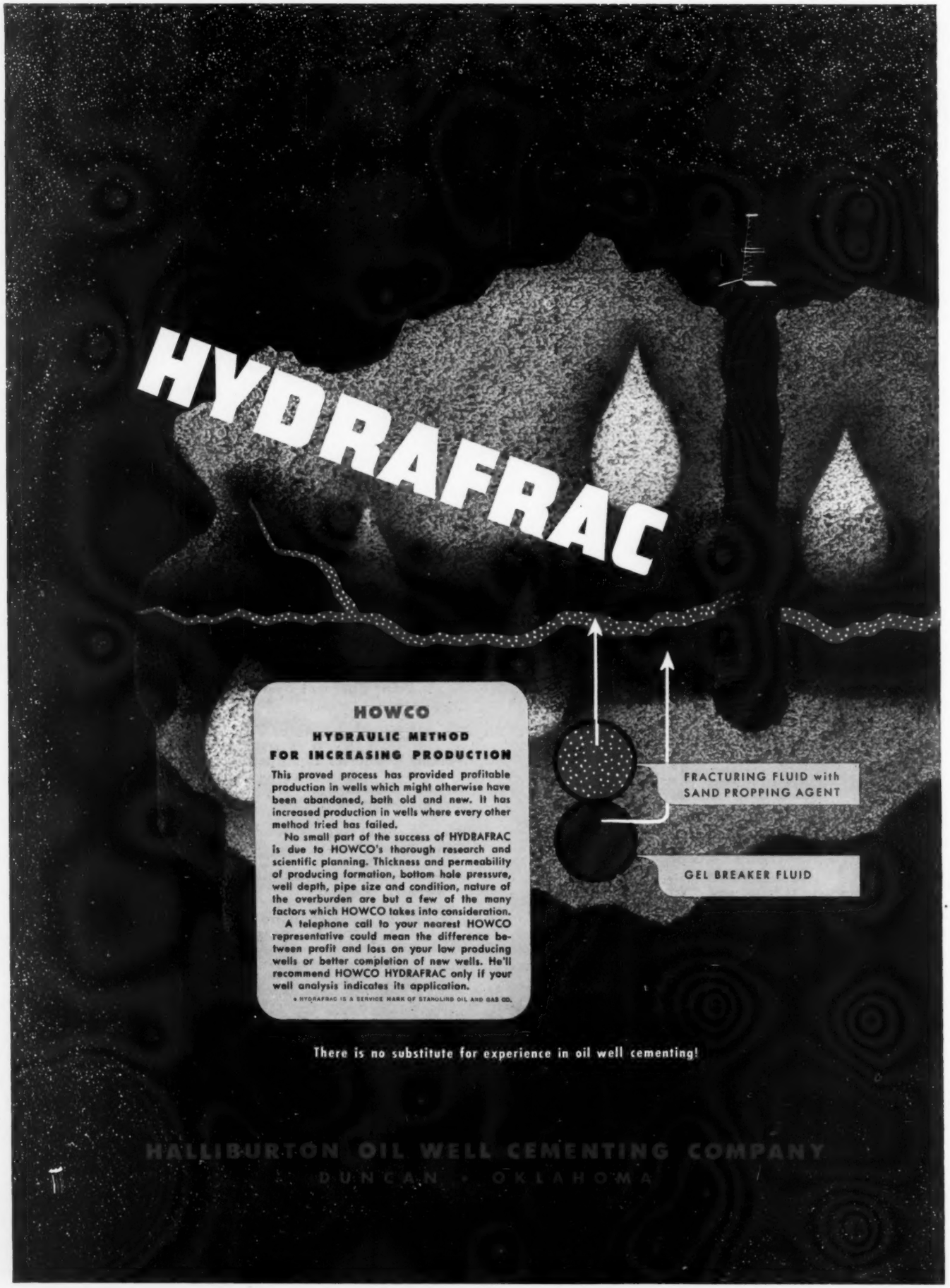
THIS MONTH'S COVER

Alfred Panepinto, staff artist for Sun Oil Co., has captured on canvas the movement and spirit of refinery construction in this view of the $20 million construction program now under way at Sun's Toledo refinery. A catalyst kiln is being swung into position. Color plates are reproduced through the courtesy of the editors of Our Sun, house magazine of Sun Oil Co.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Editorial

Refining Picture One of Constant Change

THE pattern of the world's refining industry has undergone substantial changes within the past decade. In general, however, these changes have followed the course of developments on the producing side of the oil industry. In 1939 the United States contributed 60 percent of the total world production while in 1949 its share, though it had grown by a milllion and a half barrels daily, was only 54 percent of the total. Put otherwise crude production increased 45 percent while in the outside world the gain was 86 percent.

Refining has followed a similar course, though somewhat more laggardly. At the beginning of the decade the United States possessed 62 percent of the world's refining capacity while in 1950 its proportion is 58 percent. Of cracking capacity 74 percent, however, is still held by American refiners. The expansion of processing facilities has been accelerated since the war and they have been enlarged by two and a half million barrels.

The trend thus disclosed is likely to continue for the immediate future. It is a logical outcome of the extensive discoveries that have been made in various areas and of the desire of countries with large consumption to save foreign exchange by importing crude rather than products. Fears have been expressed in some quarters lest the movement in this direction, particularly in Western Europe, with the financial assistance extended from the United States under the Marshall Plan, may result in the overbuilding of refining facilities with a consequent possibility of extreme competion that might upset market stability.

If all the projects for new construction and expansion of existing plants that have been proposed in Europe during the past two years were to be carried out there might be real danger of the development of such a condition. While one of the policies adopted in the implementation of the Marshall Plan was the encouragement of refinery building as a means of reducing the dollar deficit of European countries in their exchange operations, the Economic Cooperation Administration has announced that its grants are intended to support the economic recovery of the countries to which they are made and will not be extended where they would lead to unnecessary duplication of facilities.

It is to be borne in mind that the consumption of petroleum products has increased more rapidly during the past two years outside the United States than within that country. Taking into account the very rapid growth of industrial activity in the countries that suffered devastation during the war it appears certain that a rising demand for petroleum products, especially for fuel oils, will prevail for sometime to come. Restrictions on the use of products have been lifted in many countries, the latest being the United Kingdom which discontinued gasoline rationing at the end of May. This decision is expected to result in a higher demand in that country although the effect may be limited to some extent by the doubling of the sales tax from ninepence to one and six which raises the price of motor fuel above 40 cents per imperial gallon.

The increase in refining capacity outside the United States which has proceeded at the rate of 14 percent annually for the past three years has been due to special conditions: the restoration of war damaged plants, the urge to improve the exchange situation and in minor degree the financial aid provided through ECA. These conditions will not operate with their present force after 1952. While new refineries will be built and old ones modernized in step with the growth of demand the pace undoubtedly will be slowed down to some extent as it has been in the United States following the heavy drive that culminated in 1948.

From the viewpoint of national security it is desirable of course to have in existence some excess capacity above that required to meet current requirements. This need was strikingly demonstrated at the outbreak of World War II and is emphasized by the precarious state of present international relations.

More urgent to the refining industry than the issue of possible overexpansion are the problems that arise from changing demands for petroleum products. The designers of automotive engines are definitely embarked on a move toward the adoption of higher compression ratios. This, together with the increasing size and range of airplanes, portends a rising demand for high test gasolines which will involve changes in equipment and will require the use of more crude to produce a given quantity of product.

Jet planes or craft employing variations of the same principle are now an integral part of military armament and their commercial utilization for swift air travel is imminent. The final word as to the fuel needs of such planes is yet to be spoken but they call for a departure from past standards. The rapid spread of dieselization, particularly for railway transport, is raising the consumption of the grades of oil that these engines require and in the case of the railroads is displacing a substantial volume of lower grade fuel oil. The use of oil for household and industrial heating continues to make headway against the competition of solid fuel while at the other end of the line there is an ever widening demand for the light elements.

On the supply side there are indications of changes resulting from the spread of natural gasoline output, from the conversion of natural gas into gasoline and other products and further along perhaps from the recovery of these products from oil shale and coal. The history of the refining industry is one of constant improvement in processes and appliances and while future developments will require frequent revision of mechanical equipment and operational procedure there can be no doubt of the industry's ability to adapt itself to changes as they occur.

Britain's Refinery Expansion Shifting Imports From Products

By E. LAWSON LOMAX

PRODUCTS in the European refinery program, nurtured by ECA and designed to supply most of the petroleum needs of western European countries from Middle East oil, is now well advanced. The rehabilitation of war-damaged plants is nearly completed, the installation of new units has taken place in numerous instances, and the construction of new refineries is moving rapidly forward.

In the United Kingdom where a yearly refining capacity of 20 million tons is the goal that has been set, the effect of growing facilities is beginning to show in increased imports of crude and a corresponding decline in receipts of petroleum products. In 1949 imports of crude reached six million tons or more than 2½ times similar receipts in 1947. For the first three months of 1950 importation of crude oil was at the rate of over eight million tons per year. Crude imports prewar, which were about one-sixth of the total petroleum imports, are now about 45 percent of the total. When present plans for refinery expansion have been put into effect, it is expected that the United Kingdom will cease to be an importer of petroleum products to any substantial extent except for certain specialties.

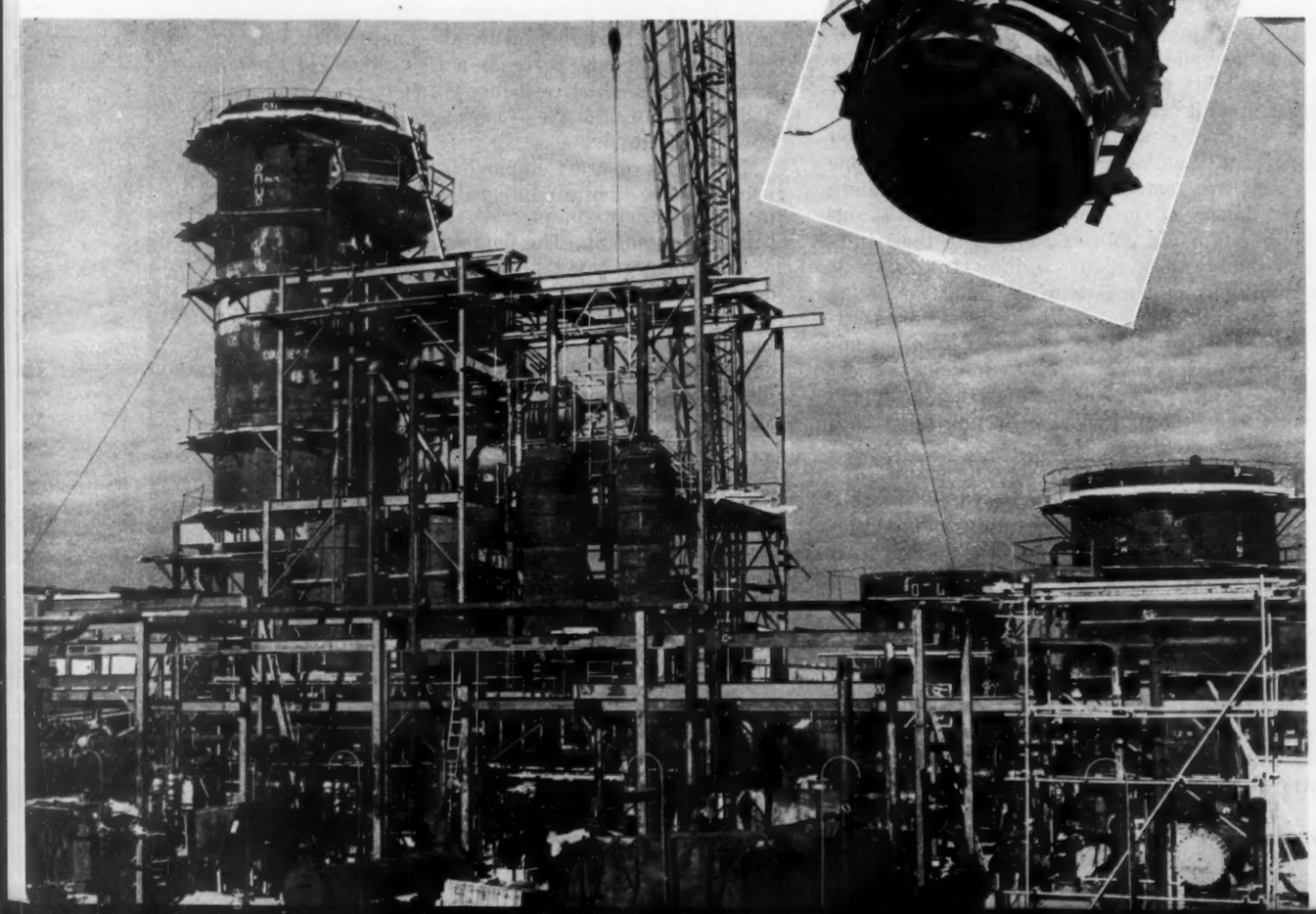
At present the most important construction work under way, in point of size at least, is the erection of the great plant of Anglo-American Oil Co. Ltd., British affiliate of Standard Oil Co. (N.J.), at Fawley near Southampton and the English Channel. The refinery is designed for a daily crude capacity of 10,000 barrels and is expected to cost around $150 million.

Work on the site began in April last, as soon as authorization was given by the government, and some 4,000 men are busily engaged in putting the preliminary work ahead of schedule. A large proportion of the underground and surface preparation, such as the installation of a railway siding on the site, grading and temporary road making, the construction of sewage and waste water schemes, the preparation of foundations, the erection of a construction camp, canteen and recreation rooms, and generally the large amount of preparation work essential to such a vast scheme before actual erection of plant can be commenced, has been completed.

Work is also well advanced on the short site for the erection of wharfage and pumphouses required for the reception and discharge of the crude oil delivered by supertankers.

Two distillation units are in course of erection; the furnaces for the pipe stills and the piping are about 95 percent complete, the convection bank being completed and most of

Erecting fractionating columns at the new Esso refinery at Fawley. Inset shows 25-ton section of tower being swung into position.



Heat exchanger bank at refinery at Fawley.

To Crude

the radiation tubes being in position. The pipes in both sections are mild steel, no alloy tubes being used.

Many of the pumps for the units are already installed, as are a large number of the heat interchangers and coolers. The shells of the fraction towers of the atmospheric unit, which are being fabricated on site, are nearly complete and plates installed. This unit will produce straight-run motor spirit, naphtha, kerosene, gas oil and fuel oils.

The erection of the combination vacuum and atmospheric unit is well along, the pipe stills are nearing completion, and the fractionating columns are in an advanced state, although not so far forward as in the atmospheric unit, while a large number of the heat exchangers, coolers and pumps are in position.

This unit, in addition to producing motor spirit, naphtha and kerosene, will also produce stock for the 33,000 barrel-per-day catalytic cracking unit. The present thermal cracking plant in the old Fawley refinery is being revamped and will be used as a reforming unit for straight-run naphtha from the new distillation units.

Foundations for the catalytic cracking unit were completed at the end of April, when 30,000 cubic feet of concrete were poured into them in a single day of eight hours, which is the largest operation of its kind that has been carried out in one day's operation in the United Kingdom. Erection on these foundations has begun, the regenerated catalyst storage being in an advanced state.

This plant being of the most modern design, great attention has been paid to flexibility of operation. According to requirements and the catalyst employed, it can be run for high octane spirit and minimum gas, or for large yields of polymerizable gases and high octane spirit, thus enabling it to cope with varying market requirements.

Middle East sour crude will form the bulk of the charging stock to this refinery, so stabilization is an important step in the process. For this purpose an Edeleanu SO_2 plant of 13,000 barrels daily capacity is being erected to treat the kerosene, jet propulsion fuels and high-speed diesel fracts. so as to reduce their sulfur content down to market specifications and incidentally to improve the burning quality of the kerosene, which will be of premium grade. Hypochlorite, doctor, copper chloride and caustic soda will all be used for final sweetening of the motor spirits and kerosenes, thus assuring that these will pass the most stringent market requirements. It is not intended to use any sulfuric acid as a refining agent for any of the products. This will ease the question of pollution, which is a very important one in a refinery of this size; special measures have been taken to avoid both pollution of water and of air.

The maintenance building, now rapidly approaching completion, will be an imposing structure on the site. Its large size, 800 feet long by 180 wide, makes it an outstanding feature, and the view from the roof gives a very comprehensive picture of the general layout of the refinery.

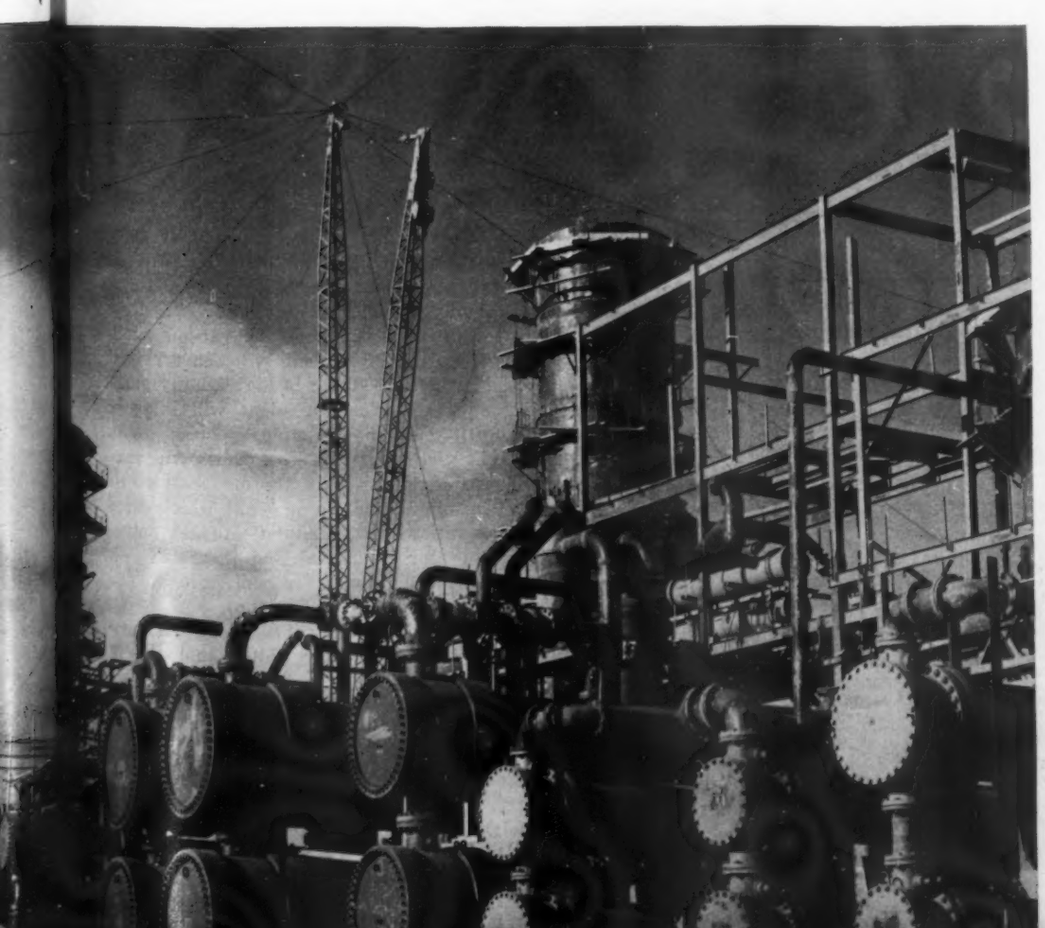
At present pipe work fabrication is being carried out in the open but will be transferred to the new building when the section for pipe work is equipped with the necessary plant. The building will be air-conditioned and is equipped with lighting to drawing office standards, so that working conditions will be comfortable under any circumstances. It is lavishly equipped, both in the maintenance and storage sections, with mechanical lifting gear so as to reduce human lifting to a minimum.

An up-to-date construction camp has been provided to house workers from a distance. The arrangements of the kitchen in connection with the canteen are of the highest standard, being such that 1,000 cooked meals can be served to the canteen at meal breaks in the short time of ten minutes. The camp is also provided with full sanitary services, recreation and writing rooms and other amenities.

A site has been chosen in very pleasant surroundings for the location of a number of houses to accommodate key members of the staff, and these will shortly be in course of erection.

The capital of this huge project is being provided by private enterprise, partly from American and partly from British sources; and while a large amount of dollars will be required for much of the equipment, this eventually will be an important dollar saving project for Great Britain, because all of the manufacturing costs for converting the crude oil into marketable products will be expended in sterling.

Foster Wheeler Corporation has charge of the mechanical design and construction of the Fawley refinery. It will also erect all offsite facilities except tankage, marine equipment, administration and laboratory buildings.



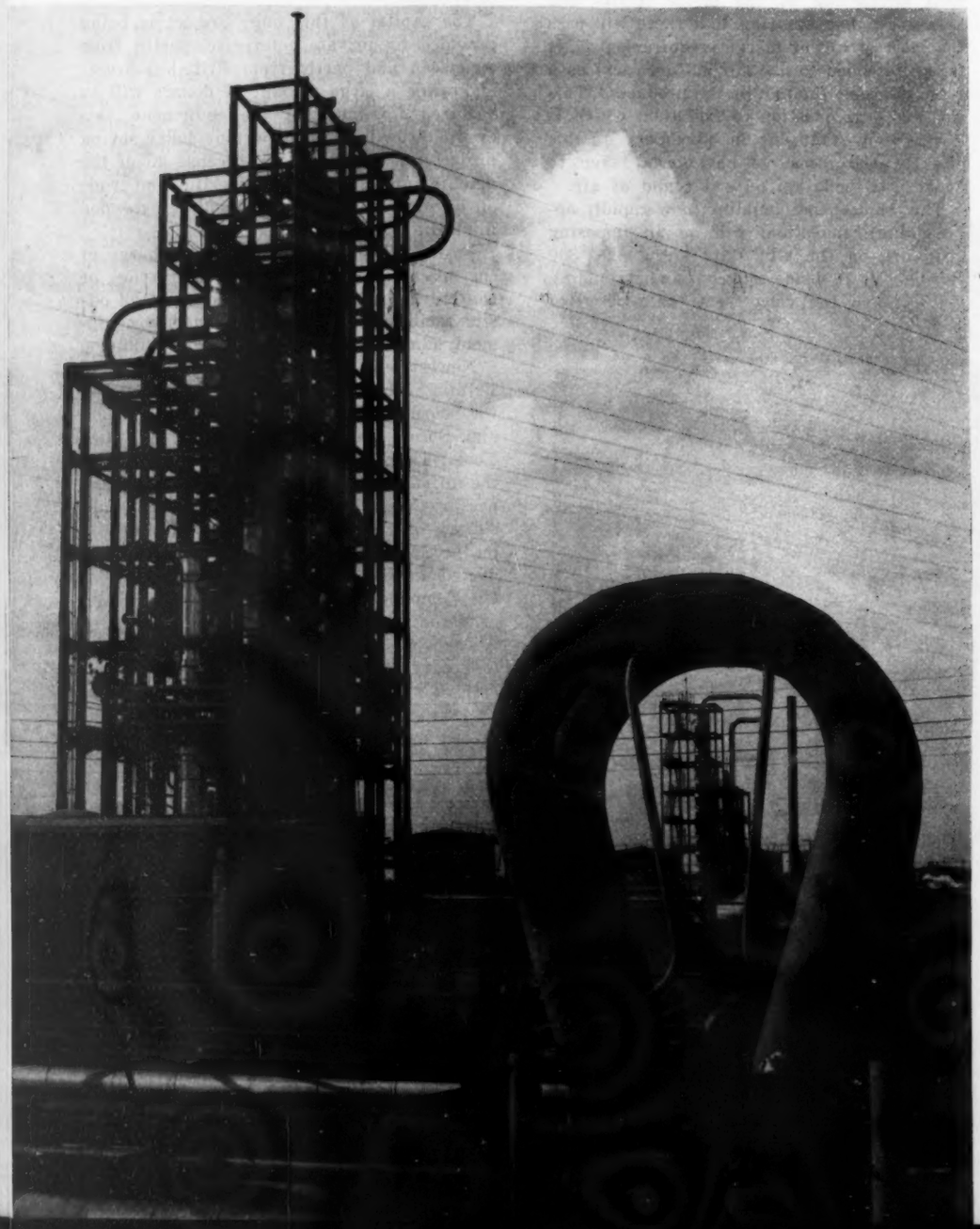
Newest refinery project to be announced in Britain is the result of an agreement between the boards of Powell Duffryn Ltd. of London and Socony-Vacuum Oil Company of New York. This provides for the incorporation of the oil storage, blending and packaging business of Cory Bros. Ltd. (a wholly-owned subsidiary of Powell Duffryn Ltd.,) at Coryton on the Thames Estuary into the business conducted in the United Kingdom by Vacuum Oil Company Ltd., wholly owned subsidiary of Socony-Vacuum.

The thus enlarged Vacuum Oil Company will carry on the combined businesses and will erect a new refinery, primarily for the production of lubricating oils, under the well-known Vacuum trade names of Mobiloil, Gargoyle and other special brands. Approval has been received from the Board of Trade for the location of the refinery at Coryton, thereby permitting the use of the existing tankage and other facilities.

The new refinery will process mainly Middle East crude, and the resulting products will replace those at present imported from dollar sources. The capital expenditure by Vacuum Oil Co. on the construction of the new 850,000-ton refinery and other works at Coryton and elsewhere will be in the neighborhood of $28 million. Construction will begin as soon as the necessary design work has been completed.

Shell has two refineries in course of construction in Great Britain, work on which

Cooling tower which handles 22 million gallons of water daily at Llandarcy refinery of Anglo Iranian Oil Co. Ltd.



is going forward according to plan. One is located at Stanlow, Cheshire, and the other at Shellhaven, Essex. Both are scheduled for completion early in 1952, when their combined capacity will be roundly six million tons yearly.

At Stanlow, extensions were commenced in 1948 to erect a modern plant to operate on Middle East crude for the production of gasoline, diesel oil and fuel oil for the home market and to provide some of the specialized feed stocks previously imported. The first of the new crude distillation units began operation at the end of 1949. The second section to be completed is a reforming unit which came into operation in May of this year, two months ahead of schedule.

The following is a list of the units proposed or in erection at this plant, together with the names of the responsible designers and erection supervisors:

Process Unit	Designer	Erection Supervisor
6,000-ton distillation unit	Shell & N. V. Comprimo	Foster Wheeler Ltd.
Feed preparation unit	Lummus Co. & UOP	Lummus Co.
Heaters for distillation, feed & preparation units & reforming plant.	Lummus Co.	Lummus Co.
Doctor treating plant	Lummus Co.	Lummus Co.
Catalytic cracker	Foster Wheeler & N. V. Comprimo	Foster Wheeler Ltd.
C_4 treater	Head Wrightson	Head Wrightson
Polymerization units	UOP & Lummus Co.	Lummus Co.
Alco distillation unit	Alco	Foster Wheeler Ltd.
H_2S removal	Shell & Girbotol	Lummus Co.
Asphalt heating unit	Shell & Head Wrightson	Head Wrightson
Claus Kiln sulfur recovery	Shell	Simon Carves Ltd.
Boiler plant	Babcock & Wilcox	Babcock & Wilcox
Water treating plant	Permutit	Permutit
Cooling tower	L. G. Monchel & Partners	Fred Mitchell

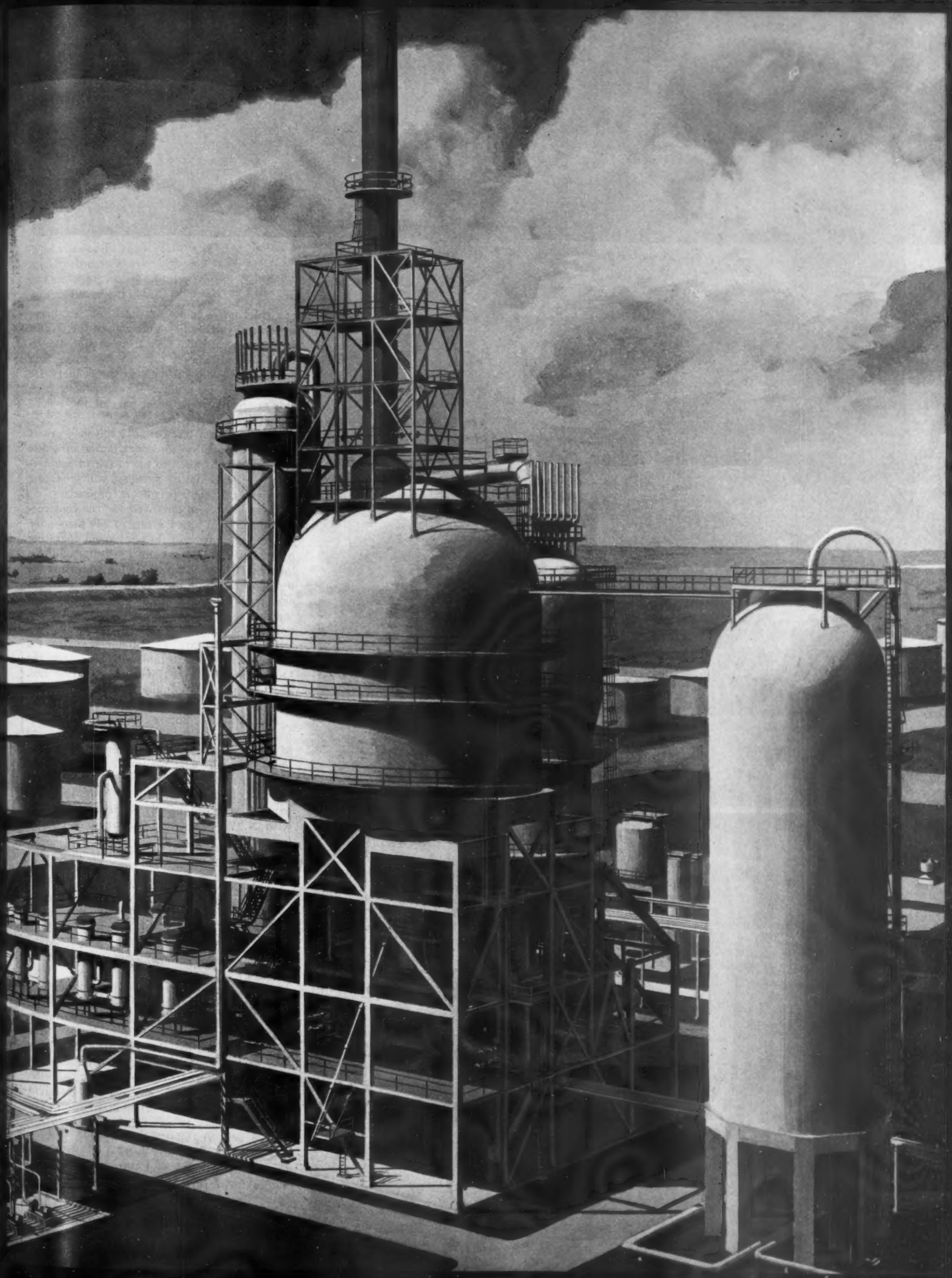
Civil engineering consultants—Maunsell, Posford and Pavry.
Civil contractors—A. Monk and Co.
Tankage—Whessoe.

The final scheme to be completed by 1952, will include two large distillation units, the latest type of catalytic cracking and reforming plants, polymerization plant and units for the final treatment of the various products. The cracking plant will convert part of the heavier distillates to high quality gasoline, and the reforming plant will improve the quality of the gasoline produced by a straight distillation. These plants will provide petroleum gases for the manufacture of chemicals in the adjoining plant which came into operation last year, and liquefied petroleum gas for industrial and domestic use. The plant when completed will have an annual capacity of 2.5 million tons.

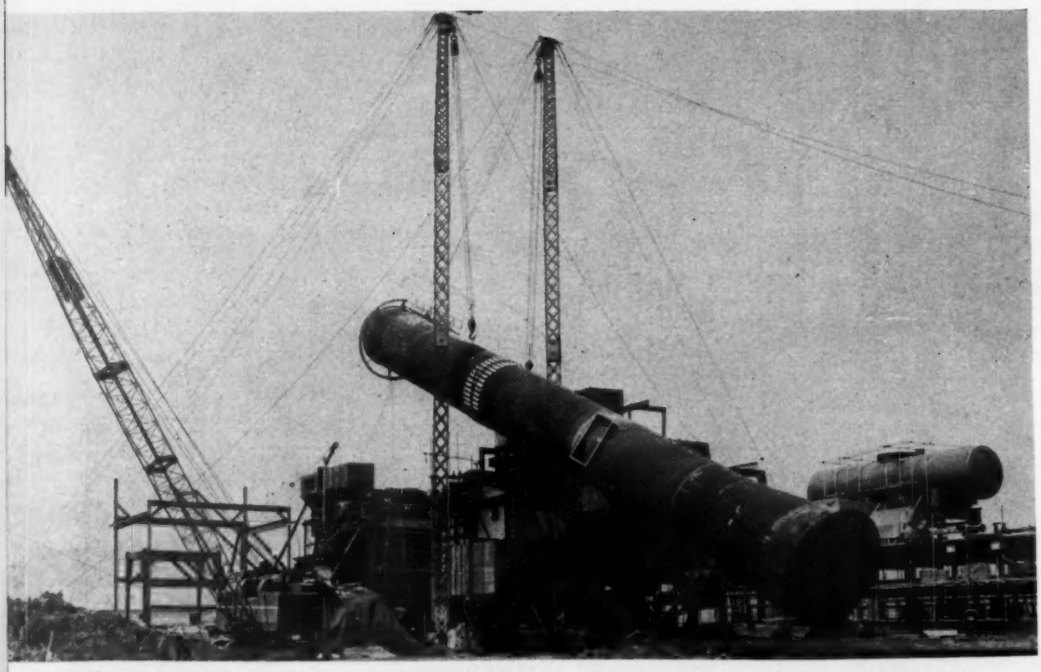
In connection with this large refinery scheme, the Manchester Ship Canal Co. is

Azaeotropic and rerun distillation unit of Petrochemicals, Ltd. ←

Catalytic cracking unit being erected by Foster Wheeler for Esso at Fawley. →

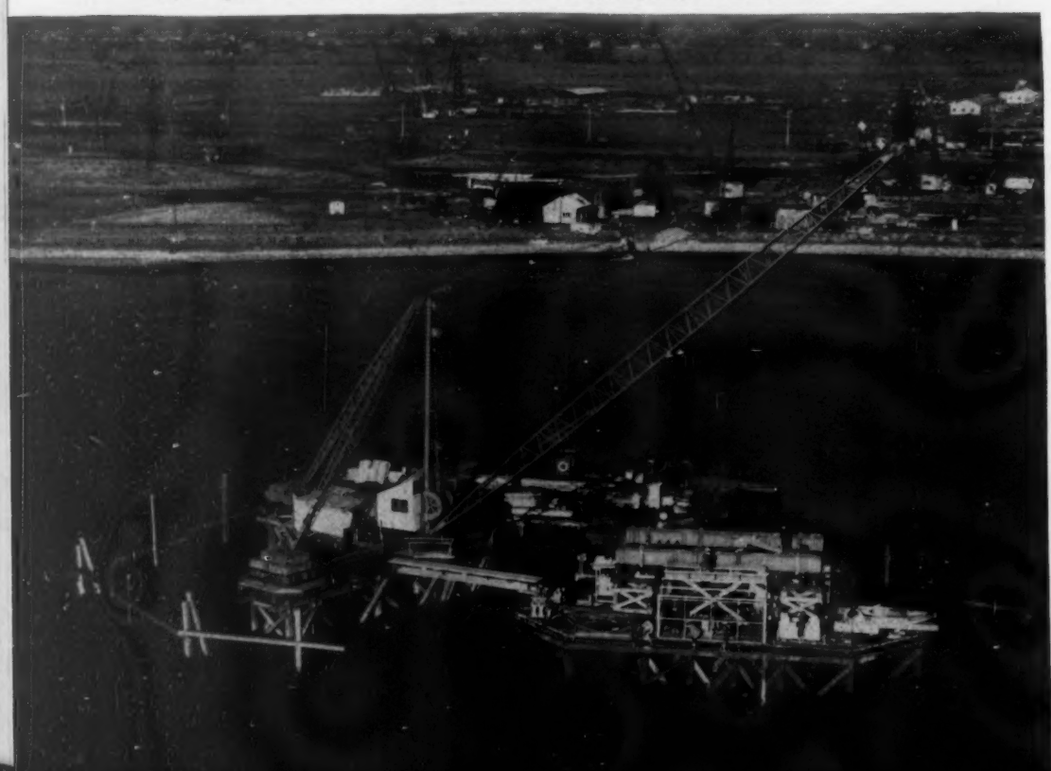


Preparing the site for the new Shell refinery at Shell Haven.



Stack being raised during construction of boiler house at Shell Haven refinery. All photographs on this page from Shell Photographic Library.

Lowering caisson as intake for cooling water supply system at Shell Haven.



constructing a new oil dock at Eastham, Cheshire, which will accommodate the largest ocean tankers which will bring crude oil from the Middle East. A pipeline five miles long connects the new oil dock to the refinery for the transfer of crude. The products from this crude replace a great part of the refined oils at present imported.

At Shellhaven more than 2,200 men are at present engaged on the construction of a new refinery which, when in operation in conjunction with the existing refinery, will produce a complete range of petroleum products.

Plans have been approved for the construction initially of a new estate of 140 houses for the accommodation of the permanent operating personnel. A 900-foot tunnel is being built below the Thames to carry cooling water for the installation, while an additional large-dimension pipeline, some 30 miles in length, is being installed to provide domestic water for both the housing site and the refinery.

Preparations are well under way for the conversion of certain tankage leased from the London and Thames Haven Oil Wharves Ltd. and which will eventually be operated in conjunction with the new refinery.

A distillation unit of 6,000-ton daily capacity is scheduled to go on stream at the end of 1950. It is a three-stage, pressure, atmospheric pressure and vacuum, and is designed to process Middle East crude carried in the new 28,000-ton tankers built for the company. It was designed by Shell in conjunction with N. V. Comprimo (Holland) and is being erected under the supervision of Foster Wheeler Ltd. The heaters for this unit, which are already erected, as well as those for the feed preparation unit and the reforming plant, were designed and erected by The Lummus Co.

The 1,250-ton daily reforming unit was designed by UOP and Lummus and is being erected by the latter company. It is scheduled to be in full operation by May 1951 and will process naphtha or light gas oil.

The feed preparation unit of 2,500 tons daily capacity was designed and is being erected by The Lummus Co. and it will be worked for the preparation of feed stock for bitumen to be handled by the existing Shellhaven refinery. The doctor treating plant, likewise designed and being erected by The Lummus Co., has a capacity of 1,300 tons per day straight-run gasoline from the crude distillation plant. It is scheduled to come into operation conjointly with the distillation unit.

The boiler plant was designed and is being erected by Babcock and Wilcox. The layout allows for future installation of a duplicate

set of boilers, as further refinery developments proceed. The layout also incorporates facilities for the supply of compressed air for refinery services of all kinds. The water-treatment plant has been designed and is in course of erection by Permutit Ltd.

Electric power for refinery operations is obtained from the local authorities Tilbury and Raleigh 33,000-volt grid systems to the refinery intake substations. These supplies come in separately, thus affording a stand-by insurance against the failure of one center. The voltage is reduced to 6,600 for distribution to the substations in the refinery.

Consulting civil engineers for the plant are Maunsell, Posford and Pavry, London. Civil engineering contractors are John Mowlem and Co., London; and tankage is being supplied by Whessoe Ltd.

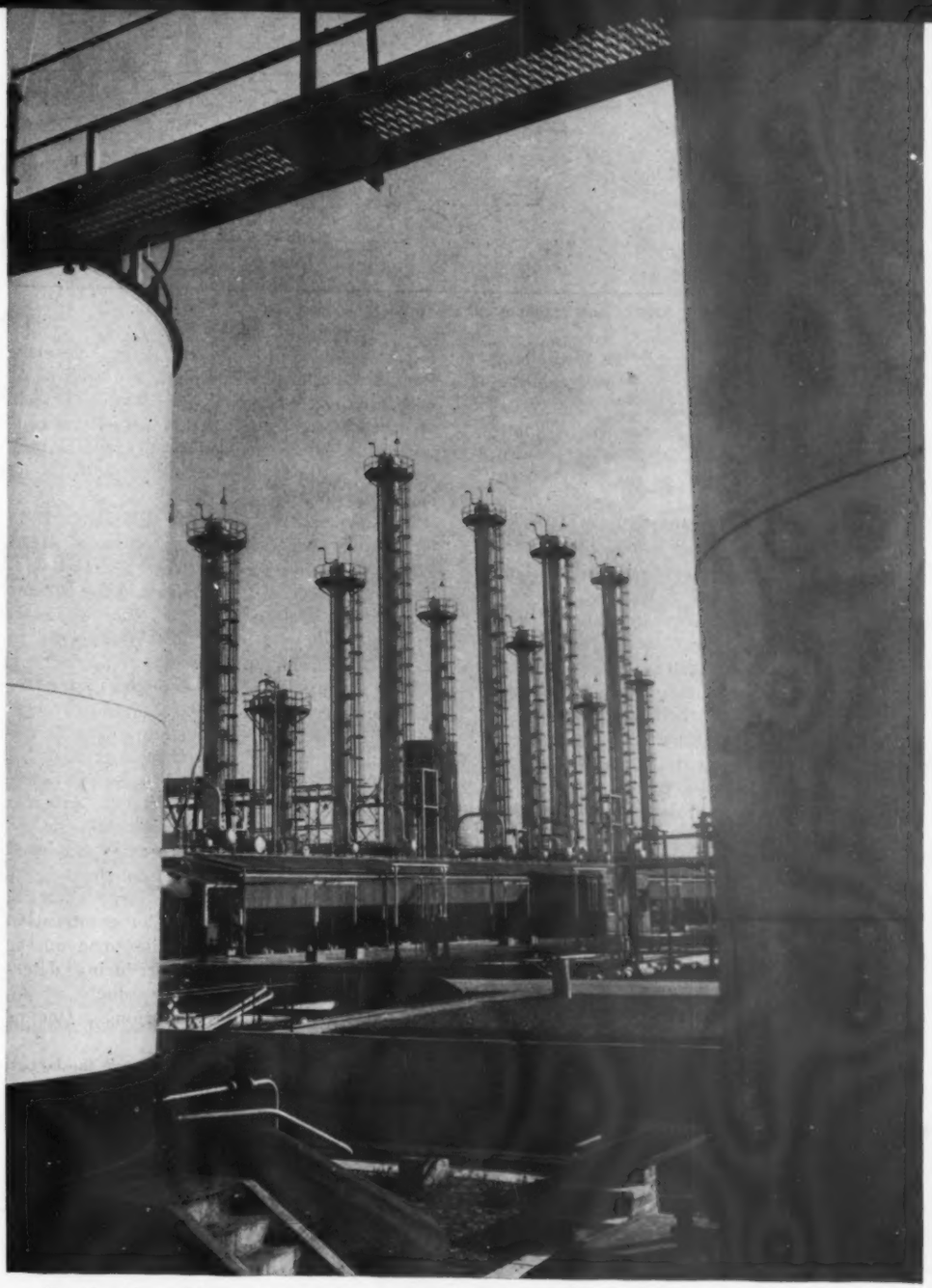
The Heysham refinery, purchased by Shell a few years ago, continues to function satisfactorily at its yearly rated capacity of 1.5 million tons.

At the Llandarcy refinery of National Oil Refineries Ltd., manufacturing subsidiary of Anglo-Iranian Oil Co. Ltd., an extensive program of expansion is now in its third year. With the installation of a 40,000-barrel daily distillation unit completed in September last, crude capacity was raised to 46,000 barrels daily. The next stage of enlargement now in progress includes a catalytic cracking unit and a lube oil plant of 1,200 barrels daily capacity. A 3,000-barrel SO_2 solvent extraction plant will produce kerosene. An ECA grant of $7,250,000 was made several months ago for the project, the total cost of which is estimated at $48 million.

First stage in the enlargement of Grangemouth refinery of Scottish Oils Ltd., another subsidiary of Anglo-Iranian, is scheduled for completion by the end of 1950. It will raise daily crude capacity from 14,000 to 30,000 barrels by incorporation of a crude topping unit, an alkylation plant and a copper chloride sweetening installation. The second stage of the program will include the installation of catalytic cracking facilities, catalytic polymerization plant and various treatment plants, due for completion by the end of 1952. Work recently has begun on the pipeline to be laid from Finnart, on Loch Long on the west coast of Scotland, across country to Grangemouth, to facilitate crude deliveries and in particular to provide a deep water terminal suitable for 28,000-ton tankers.

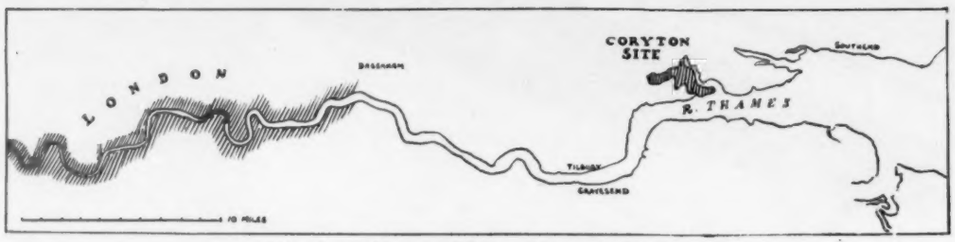
The laying of the foundations for the new heavy units at Grangemouth has presented an interesting problem of engineering, as borings revealed no solid stratum for the foundations shallower than 120 feet. The foundations have, therefore, been built as rafts on the "egg-box" principle, consisting of a concrete cellular structure, with concrete tops and bottoms and an air space in each compartment.

The main fractionating column of the new crude topping plant was delivered in January



Fractionating columns at new petrochemical plant built by Shell Chemicals, Ltd., at Stanlow.

Site of Coryton refinery to be built by Vacuum Oil Co., Ltd., under agreement with Powell Duffryn, Ltd. Site now is partially occupied by storage and blending plant of Cory Brothers, Ltd.



Site of new Vacuum Oil Co. refinery at Coryton.

last. The unit was designed by M. W. Kellogg & Co. and was fabricated by the Motherwell Bridge and Engineering Co. It was transported to Grangemouth by road as a single piece, and moving its 96 feet of length through the streets involved careful preparation.

A project that was reportedly under consideration a year or more ago as part of the general expansion program was that of a refinery at Isle of Grain in Kent on the east coast. This was understood to be a joint enterprise of Anglo-Iranian and Gulf Oil Corp., but it has since been reported that Gulf has withdrawn. No further information regarding it has been forthcoming recently, and no authorization for construction has been issued by the government, so that the future of the proposal may be regarded as uncertain so far as the immediate future is concerned.

During the coming year Berry Wiggins and Co. Ltd. propose to modernize their present plant at Kingsnorth for processing asphaltic crude oil for the production of bitumen and to replace the older sections of the plant with a new Foster Wheeler two-stage distillation unit having a throughput capacity of 2,000 barrels daily.

Last year Lobitos Oilfields Ltd., Ellesmere Port, brought into operation a white oil plant with a daily capacity of 450 barrels. This is of conventional type utilizing Alfa-Laval centrifuges. The company also arranged to pipe its surplus gas from its cracking plant to the local gas works.

The specialized plant of Philblack Ltd., built under the technical direction of Head Wrightson Processes and utilizing methods developed by Phillips Petroleum Co., is now nearing completion and will shortly be in full operation. It is the first of its kind to be erected in England.

Manufacture of basic chemicals from petroleum, closely related as it is to the processing of crude for fuels and lubricants, is undergoing an expansion in Britain comparable to that of the latter. This is a logical development, since the presence of large refineries assures an ample supply of materials for the chemical plants, and the processes employed are an outgrowth of refining technology.

At the present time four large chemical plants are in operation or under construction in the United Kingdom, while some of the smaller oil refineries are producing detergents and other chemical products as an adjunct to their main operations. One of these larger plants, located at Wilton, is owned by Imperial Chemical Industries Ltd. and is designed primarily to supply materials for the manufacture of ICI's main works at Bellingham. It is engineered by the M. W. Kellogg Co. and includes a thermal cracking unit of 250,000 tons yearly capacity, using petroleum distillate as its feed. The plant will be run for a high yield of C_3 and C_4 gases. Auxiliary distillation plant and a low temperature distillation unit for the separation of liquid and gaseous products in a state of high purity are other features.

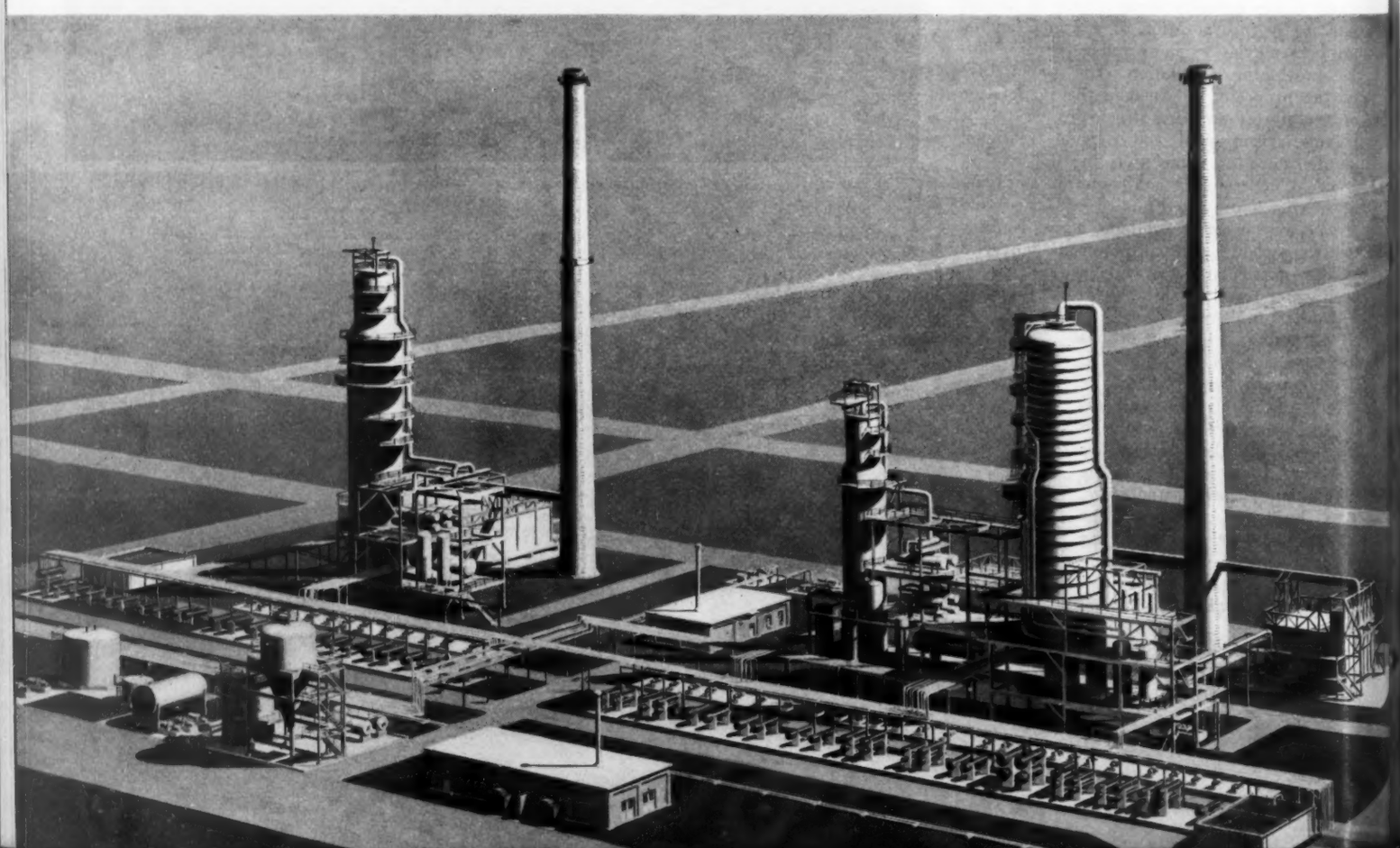
British Petroleum Chemicals Ltd., a joint undertaking of Anglo-Iranian and Distillers Co. Ltd., is constructing a plant for the production of chemicals from petroleum. It is located at Grangemouth, Scotland, and will be closely coordinated with the enlarged refinery that is being erected there.

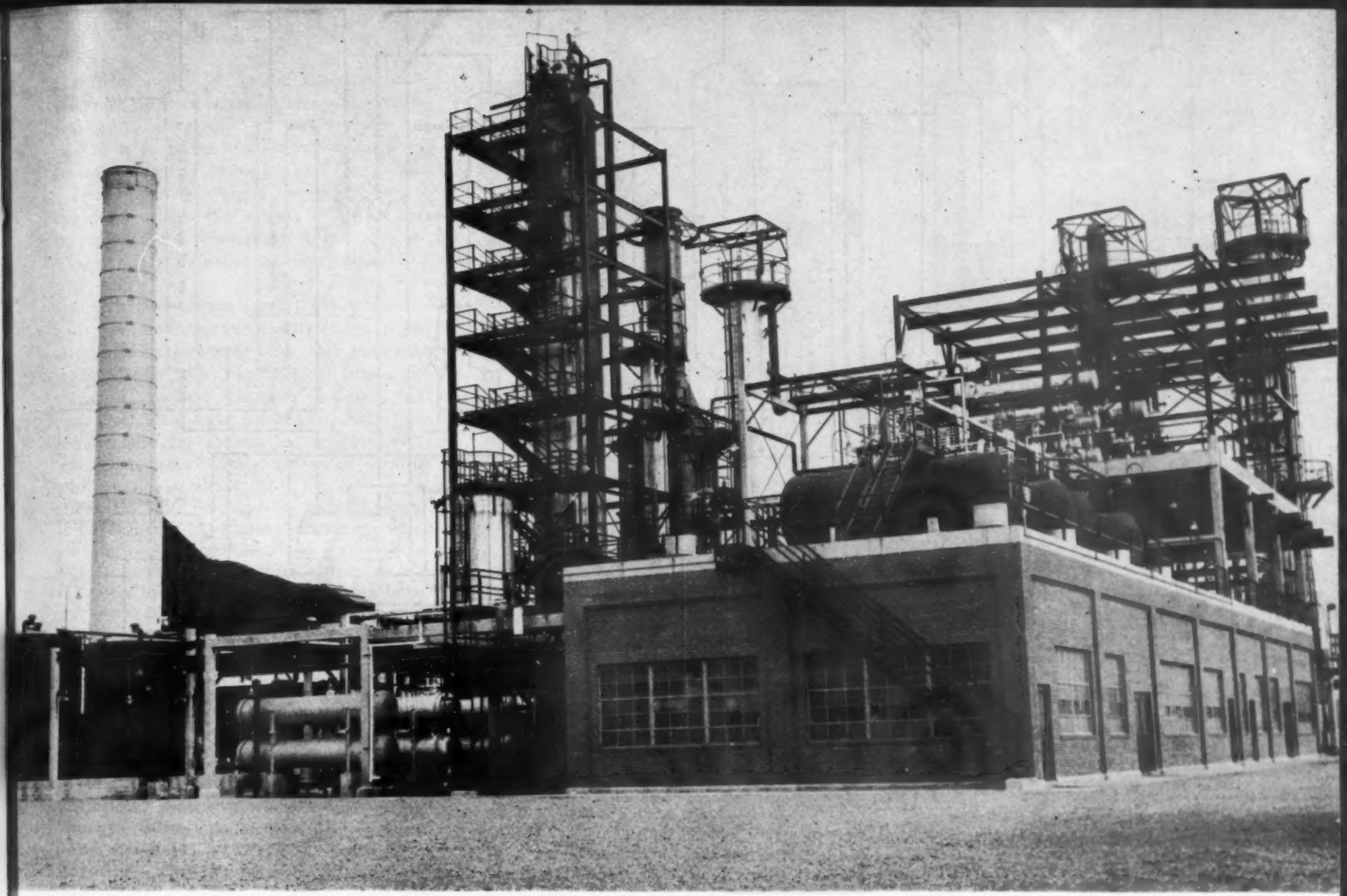
An important addition to the British petroleum chemical manufacturing industry was the opening last year of Shell's new plant at Stanlow near the company's newly-erected refinery there. Equipment of the plant includes a thermal cracking unit together with units designed to deal with the cracked products by fractionation; also hydrogenation, dehydrogenation, desulfurization, polymerization and distillation units as well as reactors and converters. Feed stock is gas oil, and products are a wide range of solvents including ketones, alcohols and ethers.

Another noteworthy addition to the chemicals group is the plant of Petrochemicals Ltd. at Partington, which is rapidly approaching completion. Some sections have been in operation for some time. The plant employs the Catarola cracking process by which

(Please turn to page 104)

Artist's drawing of mammoth distillation units being erected at Fawley. These units will have the largest capacity in Europe. Drawings courtesy Foster Wheeler Corp.





General view of furfural treating unit for middle distillates. Decanting drums are on roof of pump and control house. Treating tower is at left and recovery towers at right.

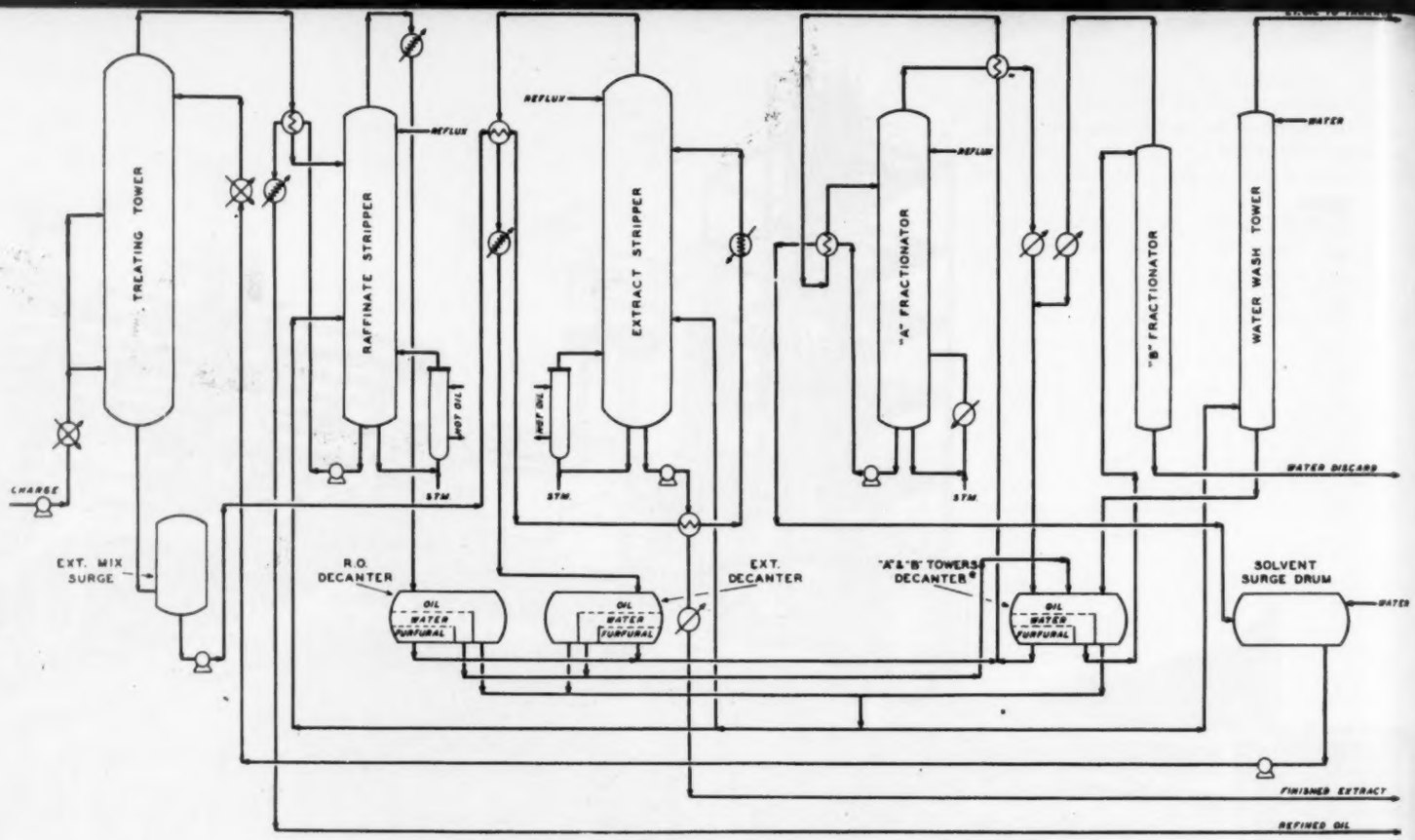
Eagle Point Furfural Unit Operates On Middle Distillates

THE Texas Company's newest refinery at Westville, N. J., which was completed at the close of 1949, is the first to incorporate in its processing equipment a unit specifically designed to treat middle distillates with furfural. The refinery, which is known as the Eagle Point Works, was designed to skim and crack high sulfur crude and has a capacity of 60,000 barrels per day. The furfural refining unit was included to permit the production of high quality, low sulfur diesel fuel and furnace oils from sour crudes and to aid in feed preparation for the fluid catalytic cracker.

The Eagle Point plant was planned for erection on deep water in the Delaware River area below Philadelphia at the close of the war. Traditional policy of The Texas Company has been to build plants in the center of marketing areas wherever possible in order to keep transportation costs at a minimum. No other company in the industry has so many plants widely scattered in the United States as The Texas Company.

The Eagle Point works is located in one of the nation's largest markets for distillate fuel oils. The market is highly competitive, however, and bids fair to become more so as the availability of other fuels becomes greater.

Recognizing these competitive considerations, the postwar planners of The Texas Company decided to erect the furfural unit to aid in tailoring the Eagle Point works to the markets to be served and to the most adverse raw materials which it might be necessary to process. There was a considerable body of commercial and semi-commercial, as well as pilot plant, data on which to base the proposed operation on middle distillates as well as the broad experience of The Texas Company and licensees of Texaco Development Corp. in the solvent treatment of a wide variety of lubricating oil stocks in all parts of the world.



Schematic flow diagram of Eagle Point furfural unit.

Prior to the outbreak of World War II, one foreign oil company was confronted with a market for high Diesel Index fuel. The oil could not be produced economically by straight distillation because of the quantities of aromatics in the crude being processed. So this company installed a furfural refining unit in its refinery to produce high quality diesel fuel oils and operated the unit in that manner until war conditions imposed other requirements upon the plant. This unit was also designed to process lubricating oils.

In addition to this experience, The Texas Company conducted extensive laboratory research culminating in pilot plant and large scale experimental studies in California in which the specific design for middle distillate extraction was further developed. The large experimental operation treated up to 2,500 barrels daily over a two-year period, processing a variety of catalytic cycle stocks and virgin gas oils.

At Eagle Point works the company now has over six months of experience in large volume operation at rates as high as nearly 175 percent of design oil charging capacity. The operators now feel that they have a satisfactorily settled procedure to do the job for which the unit was designed. Furnace oils with burning and other qualities as high or higher than virgin cuts are being produced from catalytically cracked stocks. Diesel fuel with a high cetane number and low sulfur content is being manufactured from cycle stocks. Cetane numbers as high as 65 have been obtained in commercial operation, although the normal operation is adjusted to produce stocks having cetane numbers of 50 plus. Sulfur content has been reduced by 75 to 90 percent. Accompanying Table I shows inspection reports on typical burning oils and diesel fuels.

The Texas Company's sales department has welcomed the furfural extracted products because of their special qualities. There is, of course, a shortage of virgin gas oil for cracking and for the manufacture of both diesel fuel and furnace fuel, and as a result additives have been resorted to by some refiners so that products will give fairly satisfactory service. Unfortunately additives will not change the aromatics in an oil or reduce its sulfur content as will extraction with furfural, so the new Eagle Point diesel fuels have enjoyed a substantial sales advantage because of their freedom from objectionable odor, smoking and engine deposits as well as high cetane number. Even in pot-type burners the extracted furnace oils have given satisfaction without resorting to the use of excess air for good, smokeless combustion without appreciable carbon deposits.

Research at the California plant revealed that extraction of virgin gas oils for catalytic cracking charge stock was advantageous in increasing yield and reducing carbon deposits on the catalyst. At Eagle Point only cycle stock is extracted, however, because here the advantages are much greater than in the case of virgin charge stock and capacity is not available to process both virgin and cycle stocks. The cracking value of cycle stock after furfural extraction is as good or better than that of virgin gas oils. As compared with untreated cycle stock, coke yields from furfural raffinates are substantially reduced, naphtha and butane yields are greater.

In addition to sulfur removal, the extraction of cracking stocks with furfural improves cracking susceptibility by reducing nitrogen compounds and metal contaminants. It has been shown that traces of metals in cracking stock tend to build up in the catalyst, with the result that carbon deposition is greater and catalyst activity reduced. The data from cracking of an extracted California stock as compared with cracking an untreated oil show that for the refined stock there is a yield increase of three weight percent of C_5 and lighter products with also an increase of one weight percent of C_6-400°F naphtha at a constant carbon laydown. A six percent higher butane yield (basis total butanes) is obtained and the total dry gas produced is substantially less for the extracted stock. The leaded octanes of the gasoline from the extracted stock are two to 2.5 points higher than those of the gasoline from the untreated stock. The carbon deposition is lower in the case of refined stocks, and at the higher conversion levels 25 percent less coke is obtained.

Because of the high concentration of aromatics in the extract from catalytically cracked gas oils and certain virgin stocks, it is thought that the furfural unit may be

TABLE I

INSPECTION OF TYPICAL BURNING OIL AND DIESEL FUEL EAGLE POINT

	Burning Oil	Diesel Fuel
Gravity °API	36.8	37.2
Flash, PM	158	204
Vis/100°F. SSU	33.5	35.5
Color, NPA	1½	1
Sulfur, % Wt.	0.41	0.46
Pour Point, °F.	—5	0
Carbon Residue (10% Btms)	0.07	.024
Cetane No. (Engine)	—	54.4
Distillation, ASTM		
IBP	359	420
10%	423	468
20%	437	476
50%	477	508
90%	567	574
EP	609	628

a fruitful source of special chemical products such as wood preservatives and agricultural pest destroyers. Extract analyses reveal 85 to 90 percent concentrations of higher boiling point aromatics.

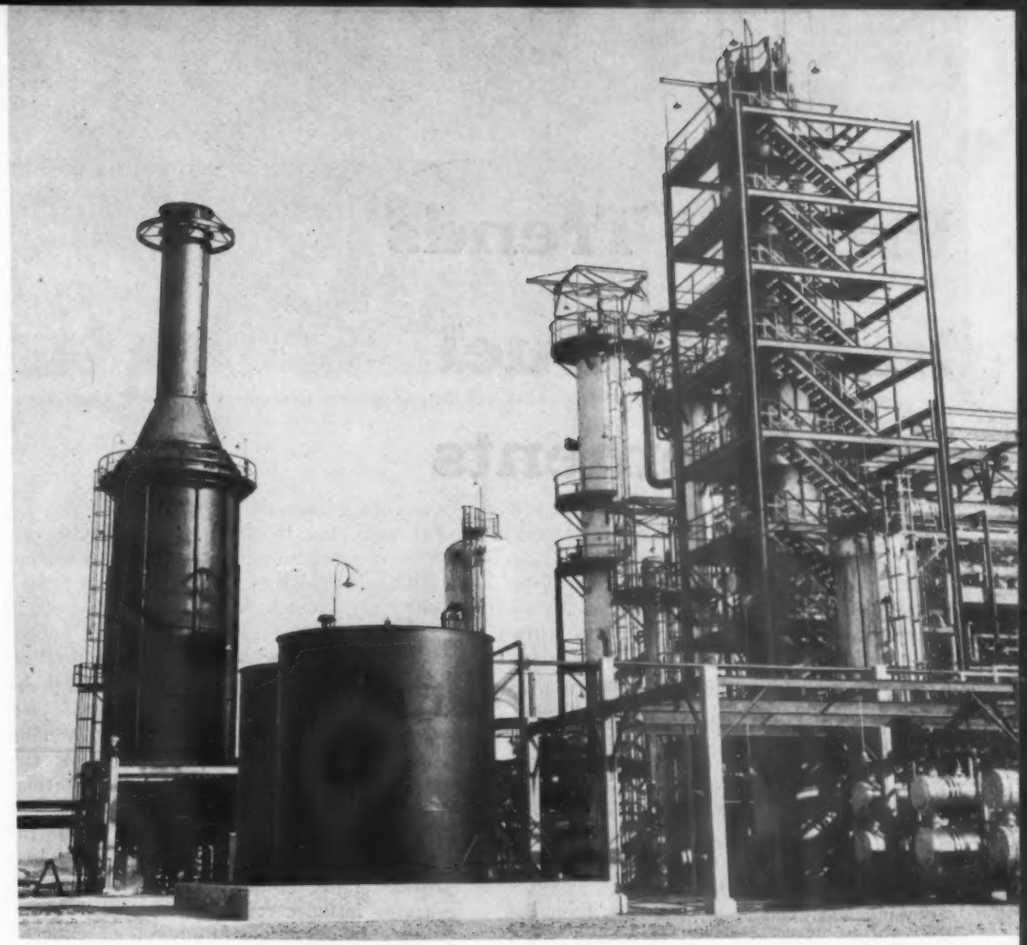
Thus far research has not progressed to the point where the extract is being further refined for recovery of these chemicals. The extract is valuable, however, for mixing with heavy fuel oil. Although testing only about 10 gravity, the extract has a low viscosity and improves the fluidity of heavy fuel oil and its compatability with other fuels with which it may be mixed in ships' bunkers or storage tanks. Samples of extract from light cycle stock are a light straw color, while from heavier ends the extract has all the clarity and bloom of a highly refined lubricating oil.

Perhaps the outstanding accomplishment in the design of the furfural unit for treating gas oil fractions has been the prevention of solvent losses. When refining lubricating oils, the stocks to be handled usually have an initial well above the boiling point of furfural, while the true initial boiling point of light catalytic cracking stock usually is in the vicinity of 325°F. Also, in the case of lubricating oil extraction where the value of the product is much greater and oil-to-solvent ratios are higher, losses are not serious from the economic standpoint. In the Eagle Point unit the loss of solvent has been held to an average figure below 0.01 percent of the oil refined by the use of a series of decanting drums in which oil, water and solvent are separated, plus suitable columns where azeotropic distillation is practiced to break up constant boiling point mixtures, and a final tower in which light oil accumulations may be washed with water to remove traces of solvent.

As indicated in the accompanying simplified flow diagram, the Eagle Point installation is similar in some respects to a lubricating refining unit, the principal difference being in the extraction tower design and in furfural recovery equipment. Process temperatures and solvent-to-oil ratios are both materially lower, however. In its essentials the unit consists of a treating tower, a vertical heater, raffinate and extract strippers plus the solvent recovery decanters and fractionators previously mentioned.

In the counter-current treating tower catalytic gas oil is extracted at temperatures ranging from 70° to 125°F, depending upon the characteristic of the particular stock. Solvent dosage, which has proved most satisfactory at Eagle Point, is about 25 percent of the oil charged to the unit, although higher rates may be employed. This compares with a solvent dosage averaging around 250 percent of oil charged to a furfural plant refining lubricating oil stocks. To prevent oxidation in the unit an inhibitor is charged to the system continuously but in very small amounts. As an alternative to the practice of adding an inhibitor, the charge stock may be passed through a deaerator to prevent oxygen entering the system.

Raffinate solution from the top of the extraction tower and extract solution from the base pass through heat exchangers to stripping columns. Reboilers for these columns are heated by oil from the vertical heater through which gas oil is circulated, which may be the oil subsequently charged to the unit.



From left to right, in foreground: Heater, solvent storage and extraction tower. Recovery section is seen in center background.

Finished raffinate is cooled and withdrawn to storage for sale or recycling to the fluid cracking unit. Finished extract is cooled and stored for blending with fuel. Condensed overhead from strippers goes to the individual decanters. Each decanter is a drum in which baffles have been installed to accelerate phase separation of oil, water and furfural layers on a gravity basis. Each phase is contaminated by minor percentages of the other two and requires further processing. The furfural phase from each of the decanters is charged to the "A" fractionator where it is dehydrated and returned to the extraction tower.

The water phase which contains a trace of light oil, and some solvent is passed through a third decanter for a second phase separation. The oil phase may be recycled through the raffinate or extract strippers. When this disposition of light oil fractions causes this phase to build up, however, the water wash tower is operated to remove traces of solvent and the light oil, amounting to less than two percent of the charge oil, which then is pumped to raffinate or extract storage tanks.

Furfural, after dehydration in the "A" fractionator, contains a small percentage of light oil, but since this has not proved to be a handicap in treating raw stock, no effort is made to remove it. Condensed overhead from the "A" fractionator is given a final decanting as shown in the diagram. The third decanter also receives overhead condensate from the "B" fractionator. The water-rich phase from this third decanter is returned to the "B" fractionator.

Operation of the unit is conducted by two men per shift. Utility requirements on the basis of currently stabilized operations are reported as shown in Table II.

Design capacity of the unit was 8,200 barrels per stream day. Recently the refinery as a whole has stepped up its throughput to around 60,000 barrels of crude oil daily from the nominal design capacity of 40,000 barrels daily. As a result, there are far more than 8,200 barrels of cycle stock available each day, and the unit has successfully treated up to 13,200 barrels daily. It is apparently economically feasible to operate the unit at even higher rates if pump capacities were greater.

The Eagle Point unit was designed by The Texas Company's engineering department and erected by Graver Construction Company.

TABLE II

Utility Requirements per Operating Day when Refining 13,200 Barrels per Day of Distillate with 3,300 Barrels per Day of Furfural

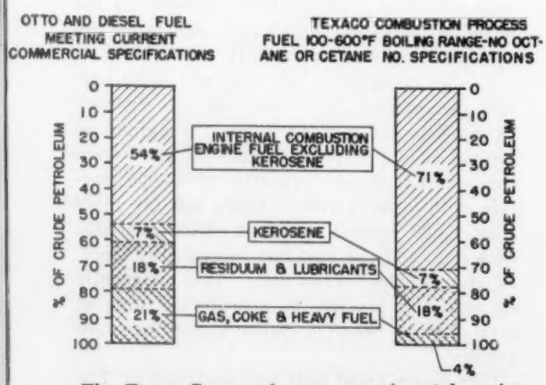
Fuel gas, millions of BTU	1,335
Steam supplied to unit @ 250 psig, thousands of pounds	565
Steam from the unit @ 15 psig, thousands of pounds	254
Net Steam consumed, thousands of pounds	311
Cooling water circulated, estimated gallons	3,300,000
Electric power for lights and instruments, kilowatts per hour per day	600

Present Trends In Motor Fuel Requirements

EVER since petroleum became the source of fuel for the internal combustion engine, the petroleum industry has been able to foresee the needs of the engine designer. In fact, it was often the advances in petroleum technology that pointed the way toward more efficient engines, and when these engines went into commercial use, the fuels were ready at the filling pumps for them.

Supply and demand have always been the two variables with which the petroleum industry has had to cope. In the early days of its history after the Civil War, the demand was for illuminating oil, or what is known today as kerosene. Along with kerosene, which was separated from the crude by a single distillation process, there were produced large quantities of naphtha or gasoline and heavy oils rich in paraffin. Everyone is familiar with the somewhat extreme measures the early operators employed to get rid of the naphtha for which there was no market. A substantial part of it must have been blended with the illuminating oil, if the records of kerosene yields are accurate, for some refiners were converting 75 to 80 percent of the crude into oil for illuminating purposes.

The introduction of the automobile about the turn of the century brought about a rapid increase in demand for gasoline, while the market for oil for illuminating purposes began to decline as electricity came into use.

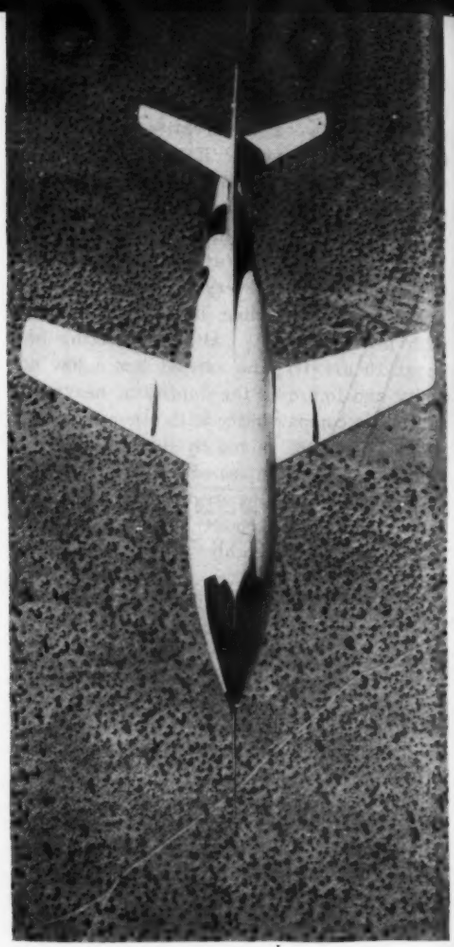


The Texas Company's new experimental engine is said to use a much wider fraction of crude than today's commercial engines.

Petroleum refiners were faced with the problem of increasing the yield of gasoline, for the quantities of straight-run fuel available were insufficient to meet the needs of the automobile industry. About 1912 thermal cracking of heavy residue was introduced with the result that gasoline yields were increased and engine performance was improved. Later improvements in thermal cracking included reforming by which it was possible to upgrade straight-run gasoline of low octane number, and vapor-phase cracking whereby good yields of components for polymerization to high-octane blending stocks were produced.

Thermal cracking, therefore, was capable for almost twenty-five years of producing high quality fuels in sufficient quantities to meet the needs of the automotive industry. Petroleum technologists, however, realized that the demand for gasoline would continue to increase, and they anticipated the automotive and aviation industry would be seeking fuels having octane numbers in excess of the 72 octane number fuel (unbleached) that was obtained by thermal processes. All through the '30's extensive research programs were being carried on, although at that time it was generally conceded that the then current refining techniques would not become obsolete for fifteen or twenty years. Nevertheless, methods were developed for catalytic cracking, polymerization, isomerization and alkylation, and as the prospect of war became inevitable, these processes were put into operation. As a result, the country was fortunate in having ample supplies of high octane aviation fuels as well as such vital materials as toluene for explosives and butadiene for synthetic rubber.

So much for the past. What we are now concerned with are the demands on the petroleum industry within the next five years. There are indications that these five years will see drastic changes in the demand for petroleum products. The supply picture, too, probably will alter, particularly within the United States, with imported crude being used to a limited extent to supplement domestic supplies. Crude imports, if they are needed, will not be so difficult to cope with as the changing picture of demand for products.



U. S. Navy Skyrocket employs dual rocket and jet engines to fly into the supersonic and return to base under its own power. Douglas Aircraft photo.

Forecasting, or crystal ball-gazing, is a hazardous undertaking, but the time has come when an understanding of certain well-defined trends is possible. A realization of these trends is essential in long-range planning for refinery expansion, even though at this time it is impossible to predict with certainty the actual direction or the full dimensions that some of the trends will take.

For example, the automobile industry has embarked on a program of more efficient engines by increasing compression rates. General Motors has taken the lead in this direction with its 7.5:1 Cadillac, a ratio that can be increased to 10:1 by changing the head. Oldsmobile is using an entirely new engine, based on the Kettering engine, with a 7.25:1 ratio, but with only a few minor changes this can be increased to 12:1 as soon as higher octane fuels are available. Other manufacturers who have recently upped the compression ratios on their cars are Buick, Crosley, Kaiser, Nash, Plymouth and Studebaker.

As can be seen from Figure 1, with engines designed according to current practice, an increase in compression ratio from seven to nine calls for an octane number increase of 10 units from 90 to 100. In June of this year premium grade gasoline being marketed throughout the country had an average octane rating of 89, an increase of 11 units since 1941. On the East and West Coasts where hills make premium fuels even more desirable, the average rating was 92. If we can assume that the trend to increase compression ratio continues, we can expect a de-

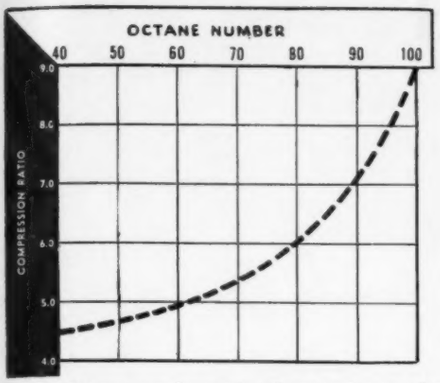


Fig. 1. Octane requirements of present cars rise sharply above 7:1 compression ratio.

Vickers Viscount, turbo-prop airliner which has been ordered by British Overseas Airways.

mand for 100 octane automotive fuel by 1955.

Present refining capacity is being taxed to the utmost to produce present fuels, and these are only possible by the inclusion of tetraethyl lead. Sun Oil Co., which has long been in a position to supply an unleaded fuel, recently started to market a leaded product. It is estimated that by 1952 the petroleum industry will be in a position to produce one barrel of 100 octane fuel for every four of regular automotive fuel, but it is questionable whether this will meet the needs of the motoring public.

That the oil companies are taking a serious view of the approaching drain that will be imposed by the rising demand for high octane fuels is evidenced by two recent papers presented before the American Petroleum Institute and the Society of Automotive Engineers. R. P. S. Pigott of Gulf, in a paper, "Compression Ratio, Octane Demand and Lubrication," prepared for the API lubrication committee meeting in Detroit in June, pointed out that to increase ten octane numbers by refining would cost the oil industry somewhere between two and three billion dollars. He proposes that the automotive industry reduce the octane requirements of its engines without reducing the compression ratio or the efficiency, by design changes. This, he estimates, would cost from three to five hundred million—not much more than the usual cost of new models. In concluding his paper Mr. Pigott said: "While it has been customary in the past for the oil industry to do pretty much what the automotive industry demanded, we have now reached very close to our predictable limit. I think it will be recognized, and is being recognized, that the oil industry should not be asked to spend five to ten times as much to accomplish the results as it would cost the automotive industry to do it even better."

Barber, Reynolds and Tierney of The Texas Co. are the authors of a paper, "The Elimination of Combustion Knock—Texaco Combustion Process," that was read before the summer meeting of the Society of Automotive Engineers at French Lick, Ind. In it they describe a method of combustion in the spark ignition engine that is insensitive to the compression ratio, degree of supercharge or octane number of the fuel. An engine utilizing this combustion process, they claim, will be able to handle fuels boiling between 100 and 611°F and have no octane or octane number requirements.

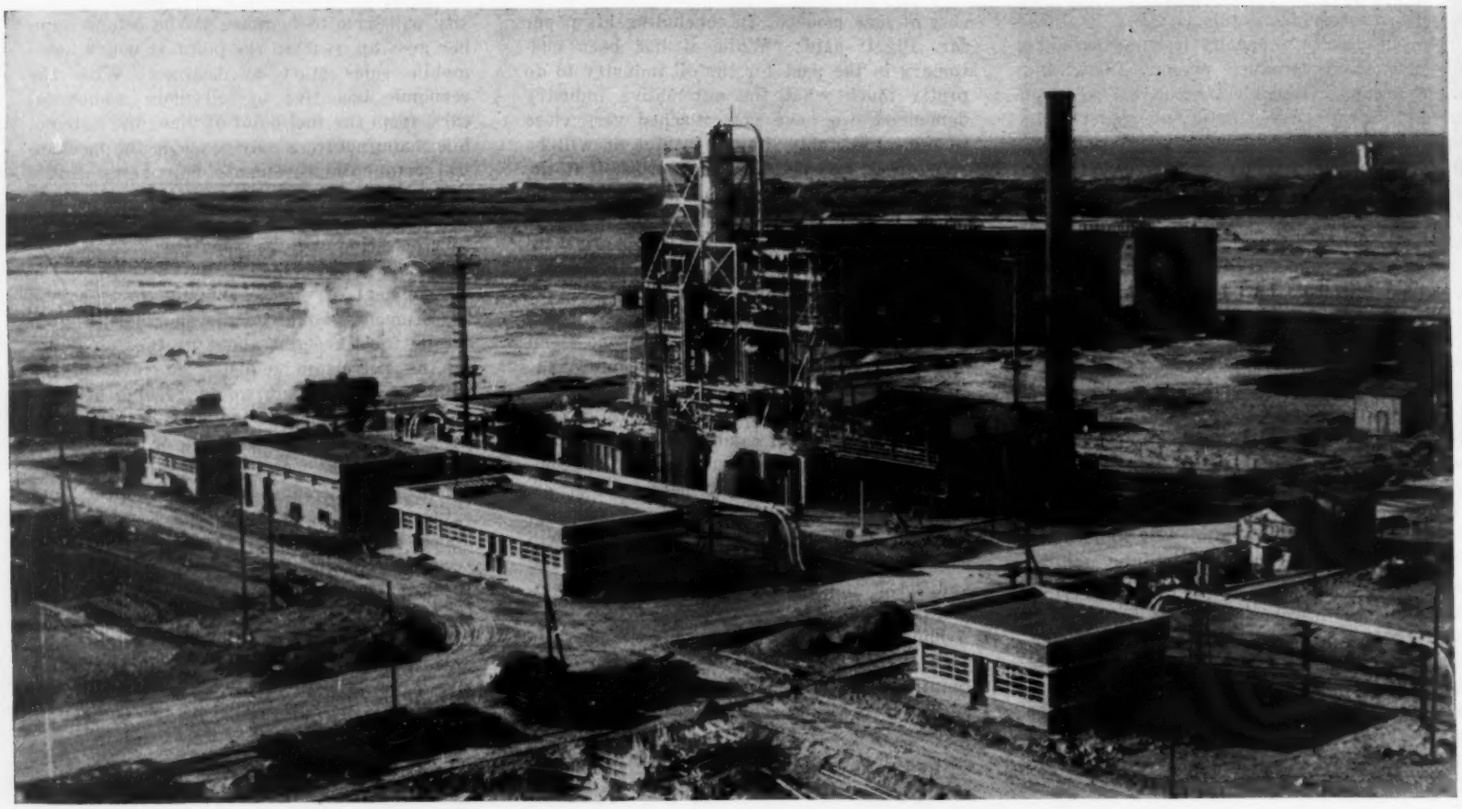
Thus we see that there are two alternatives with regard to automobile engines. Octane requirements may increase, or the engine makers may design engines with more catholic fuel tastes. The latter alternative, however, probably will not be pursued until the price of automotive fuel, which of necessity will have to increase as the octane number goes up, reaches the point at which automobile sales start to decline. With the economic incentive to sell more economical cars, from the fuel point of view, the automobile manufacturers may consider the mechanical octane improvements now being investigated by the petroleum industry. At the moment, however, it seems that no trend in this direction will be apparent before 1955. The only factor that might accelerate the development of engines having lower octane requirements would be the shortage of high octane fuels brought about by the reluctance of the petroleum industry to invest large sums in plants that would become obsolete once the automobile industry starts using these engines. This shortage of high octane blending stocks can be alleviated to some extent by improving and putting into more extensive use methods to increase the antiknock rating of straight-run gasoline. A recent development in this direction is the UOP Platforming process. A description of the first installation of this process for the catalytic reforming of naphtha, which is being operated by the Old Dutch Refining Co. at Muskegon, Mich., was given in WORLD PETROLEUM for April. Unleaded octane number of the raw naphtha before processing is about

(Please turn to page 102)

Avro Canada jetliner making its first visit to the United States last April. It is scheduled to fly the Atlantic this summer.

French Refineries Equipped To Meet National Needs

By HENRI M. BALLANDE
Vice Chairman OEEC Oil Committee



Raffinerie de Dunkerque topping unit transferred from Courchelettes.

IN the course of the year 1949 which marked a decisive progress in the recovery of France, the oil refining industry exceeded by 40 percent its record for the preceding year by treating 84,158,000 barrels of crude oil as against 66,558,000 barrels in 1948.

This progress has continued during the first months of 1950, and from June 1, 1949, to May 31, 1950, the industry has treated 89,329,000 barrels of crude oil.

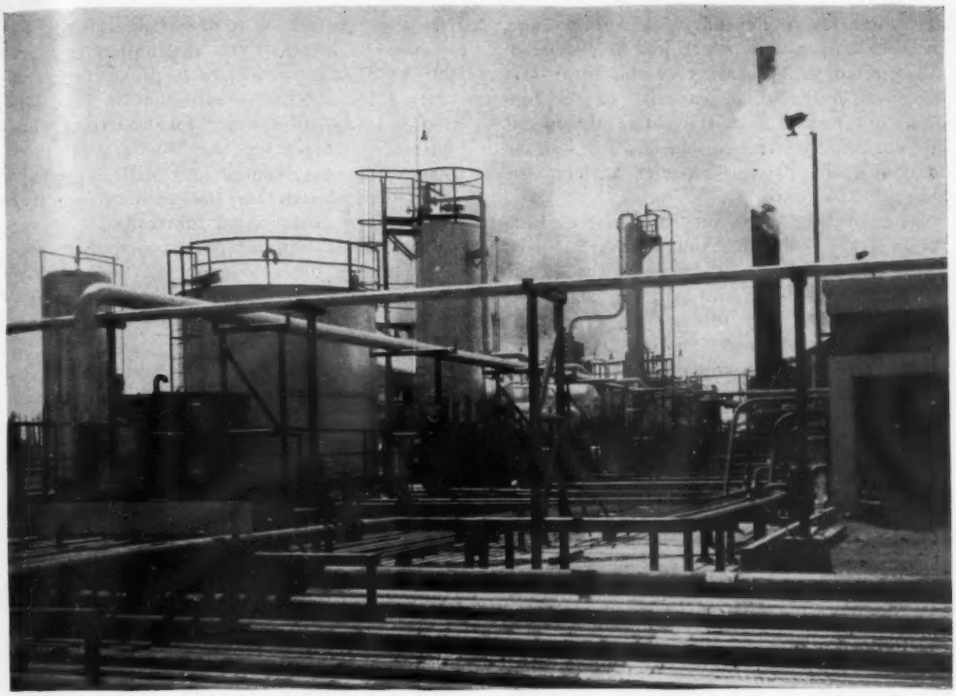
During the same period there appeared two new facts to characterize the supply of petroleum products to this country, facts important to the French economy because they brought about a saving of dollars. On the one hand was the discovery of new productive horizons in the old Pechelbronn field (July 1949), and near the Pyrenees (at Lacq in December). For the first time French production during the past 12 months has passed the old ceiling of 400,000 barrels to reach 489,000 barrels; during the month of May it reached 60,000 barrels. While it is impossible at this moment to foresee how far this production will increase, it is worthy of note that for the first time France is able to behold some encouraging results.

On the other hand, in July 1949 there came into service the north branch of the 16-inch pipe line system of Iraq Petroleum, and the Qatar field came into production. By these developments the share of the Campagnie Francaise des Petroles in Middle East oil was raised to 7,893,500 barrels, which amounted to a recovery of 136 per cent in comparison with the 12 preceding months.

In this connection it may be remarked that the French deplore the local political difficulties which have deprived France of 16,381,200 barrels of crude oil that could have been paid for in francs since the southern fork of the Iraq pipeline leading to Haifa was shut down.

This deficit for the most part has been made up by petroleum payable in ECA dollars, which has definitely become a supplementary charge on American aid to Europe.

However, the foregoing figures show that most of the French imports of crude oil have been paid for in foreign exchanges: 37,039,500 barrels in sterling pounds to the amount of $62,188,100 (exchange value), essentially to cover the needs of the subsidiaries of Royal Dutch Shell and the Anglo-Iranian Companies, and 43,823,400 (49.4 percent of the total) barrels with a value of $88,493,900 for the French companies appertaining to the American groups (Standard Francaise des Petroles, Socony-Vacuum), and the two companies without foreign participation (Compagnie Fran-



Raffinerie d'Ambès after reconstruction.

caise de Raffinage, Raffineries Francaise de Petrole de l'Atlantique).

It may be noted that the purchases payable in dollars have been almost wholly effected through the generous assistance of the Marshall Plan, which has played such a great role in the rapid recovery of France. From April 3, 1948 to April 1, 1950, ECA has financed a total of $152,172,700 worth of crude oil, $74,023,300 of finished products paid entirely to American concerns, and $78,975,500 on oil freights, making a total of $305,171,500.

It has been calculated that without the direct or indirect aid of the Marshall Plan the French consumption of petroleum products would have been reduced by 65 percent. Under such a condition, the effort toward French recovery would have been doomed to failure. As representatives of the French petroleum industry have informed the chiefs of the petroleum branch of the ECA during their travels in Europe, the Marshall Plan, so far as concerns satisfying the petroleum needs of France, has been a complete success.

At the present time studies are in progress to enable the companies normally supplied with dollar crude oil to maintain their positions in the French market after the end of ECA, in spite of the scarcity of dollars that will probably exist for several years after that time. Today nobody doubts that the general solution of this problem of exchange rests on a better equilibrium in international exchanges.

France does not ask more than to earn, by selling its manufactured products and its services, the dollars which it needs especially to effect its purchases of crude oil.

One company (Caltex) has already accepted, as of last April 1, payment of its sales in francs to the extent of 25 percent. This proportion may be increased later on, and it is hoped that it may reach and even exceed half the value of the crude. Conditions for the use of the French money accumulated by the seller will evidently raise a problem, but it is hardly to be doubted that the French Treasury will exert itself in a real desire to arrive at a formula that will give satisfaction to all interests.

It is well known that the objective of the French refining industry is primarily to meet the consumption demands of France and its nearby overseas territories. At the end of 1948 the industry was covering all the needs of the homeland and Algeria. Since July 1949 it has been meeting nearly the whole demand of the homeland, the three countries of North Africa (Algeria, Tunisia, Morocco) and a part of French West Africa. Imports were restricted to aviation gasoline of 100/130 octane number, and a moderate quantity of lubricants: 450,000 to 500,000 barrels a year.

During the past 12 months refined products have been made for the following destinations:

France (including bunkers under the French flag)	81.6%
French overseas territories	8.8%
Special treatments and exports	9.6%

The exports, although for the most part occasional, have allowed the compensation of the small balance between the domestic production and consumption, which was occasioned essentially by an excess of gas oil. As regards the special treatments, they correspond to the differences between the global capacity of an industry in the course of development, and of consumption which, restrained by taxation, has not exactly coincided with the initial estimates.

Numerous factors have influenced consumption during recent months. In first place was the abolition of rationing of automobile gasoline at the end of December. However, the price has been kept so high by heavy taxes that one may say that rationing by price is doing what was for so long done by means of coupons.

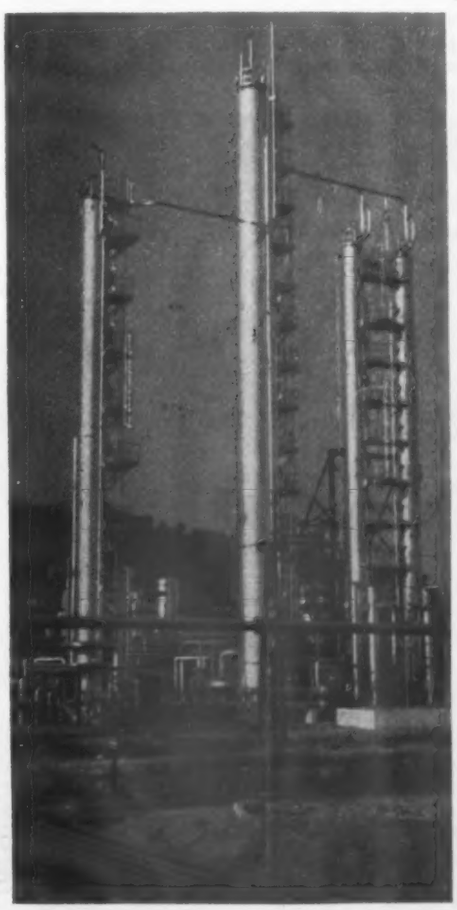
The relaxation from direct rationing, nevertheless, has produced a net increase of consumption. In 1949 consumption was 28 per cent less than in 1938, in spite of the fact that the number of farm tractors running on gasoline has quadrupled and industrial activity has increased 25 percent, which shows that consumption for non-essential purposes has decreased considerably since the war. Total consumption of gasoline in 1950 will probably again reach the level of 1938.

At the beginning of the year a ternary "super carburant" (gasoline 75 percent, benzene 10 percent, alcohol 15 percent) or premium motor fuel has been put into distribution to provide an acceptable outlet to 378,000 barrels of agricultural alcohol by government order. Its octane number (motor method) is 78, while that of ordinary gasoline is from 68 to 70. This "super carburant" appears not to be very popular with most automobilists, but it satisfies the drivers of vehicles of American make. At the present it does not represent more than six or seven percent of the total sales of motor gasoline.

In the field of fuels the devaluation of last fall brought on a period of stability of domestic prices and has reversed the price advantage enjoyed by heavy oils in comparison with coal. Although the taxes on combustible liquids have been suppressed there is anticipated a slowing down in development of the use of fuel oils, which experienced a rapid extension during the past three years.

This recession of fuel oil demand, if it takes place, combined with the normal expan-

Raffinerie de Normandie fractionating towers



sion of the gasoline market, will affect the relative proportions of the different products obtained from crude. It is probable that the present percentages (22.1 percent gasolines, 21.8 gas oil and distillates, 37.9 fuel oils) will undergo wide changes, especially as concerns gasoline and fuels.

At present equipment projects under way reflect this tendency. There is again a turn toward cracking and more particularly toward catalytic cracking which assures the best evaluation of the treated crudes. Those who have been fearful that the refining program presented last October to the ECA by participants in the OEEC would lead to a vast overproduction, will appreciate the effort of the French refining industry to adapt itself with a maximum of flexibility to the new needs of its own market. Requests for aid for this equipment have already been addressed to the ECA and there is lively hope that this aid will soon be granted.

It may be recalled in this connection that the general program of reconstruction, extension and modernization of the French refineries from 1945 to 1953 contemplates only 12 per cent of ECA funds, 88 per cent of the investments being assured from other sources, and for the most part in francs.

This partial financing of reconstruction and modernization by ECA began at the start of this year, thanks to the authorization of reimbursements for the fiscal years 1948-49 and 1949-50 issued in November and December 1949 for an amount of $5,000,000, of which about $3,500,000 was for engineering and $1,500,000 for material.

It is worth noting than an important fraction of these credits are for installations designed for improving the quality of the products; the increase of the capacity of the approved projects is limited to 34,000 B/D, which is 12 percent of the present capacity of the French refineries.

Below is given in detail the principal improvements added to refinery equipment during the current year.

Note will be taken of the moving of two new factories in February last: Dunkerque, the operating rate of which will be provisionally limited to 20 percent of the future refinery capacity by the capacity of the topping unit moved from the old establishment at Courchelettes-Ambès, which will be raised to double the prewar capacity without the help of ECA funds.

Work of the Compagnie Francaise de Raffinage-Refinerie de Normandy in 1949 has been limited essentially to the construction of the new sub-atmospheric unit which is scheduled for operation in July 1950.

The "solutizer" process for the refining of gasoline and the reforming unit for the product of catalytic cracking will be ready to function by the end of 1950.

At the Raffinerie de Provence the chief development has been construction of the new atmospheric distillation unit which will begin work in September 1950. The "solutizer" unit will probably begin operation toward the end of 1950. The same is the case with the reforming unit for the product of catalysis. A unit for refining commercial propane began work in May 1949.

The installations at Port de l'Avere have been improved by new submarine unloading and pumping systems. By the end of 1949 about 3,360,000 barrels of crude oil were unloaded at the refinery by the new "sea-line."

Equipment installations at the Raffinerie of the Shell group have included construction of a new topping unit to operate in January, 1951; an extension of the power plant which will be completed during 1950; and an enlargement of storage capacity; modernization and extension of facilities for gasoline treatment which will be finished at the beginning of 1951. The Cross cracking unit which has been transformed into a reforming unit has been operating since the end of March 1949. A new reforming unit will be completed about August 1951. Besides the erection of 14 housing units for workers, construction of an important drainage system has been begun.

At the Raffinerie de Petit-Couronne the principal work accomplished in 1949 has been the construction of a new topping unit designed to increase the distillation capacity on Middle-East crude, to begin operation in July 1950, and the construction of new storage capacity (of about 251,000 barrels). Immediately thereafter the Dubbs unit (now operating as a topping unit with a capacity 2.5 times greater than the cracking capacity) will return to its initial function.

As regards other refinery equipment, construction is proceeding at the Shell-St. Gobaine refinery on facilities for the manufacture of synthetic detergents derived from petroleum products.

Wharfage facilities for lighters and tankers are under construction at the Raffinerie de Pauillac.

Principal additions to the Raffinerie de Port-Jerome of Standard Francaise des Petroles have included the following: A lube oil refining unit by the phenol method (finished in June 1949); oil redistillation unit in service (February 1949); special gasoline unit (September 1949); and two new boilers for power plant (March 1949).

Projects now under construction include modernization of the power plant, machine shop and storage facilities, construction of 20 dwellings for employees in addition to 11 built in 1949.

At the Raffinerie de l'Avera of Societe General des Huiles de Petrole, the principal works executed in 1949 have been an extension of storage facilities. In addition a new installation has been made for manufacturing special gasolines and white spirit. Mention should be made of the construction, in the outskirts of the refinery, of a plant for the Societe Naphtachimie costing about $13 million in exchange values, financed by SGHP, Pechiney and Kuhlmann. This plant will treat about 1,300 barrels daily of products furnished by l'Avera for making glycols, acetone, solvents and other products.

During 1949 work progressed rapidly on the new Raffinerie de Dunkerque including excavations, installation of a 7,000 B/D topping unit transferred from Courchelettes, building storage tanks, of which a capacity for 690,000 barrels is now in use; the previously noted unit was put in operation in March, 1950.

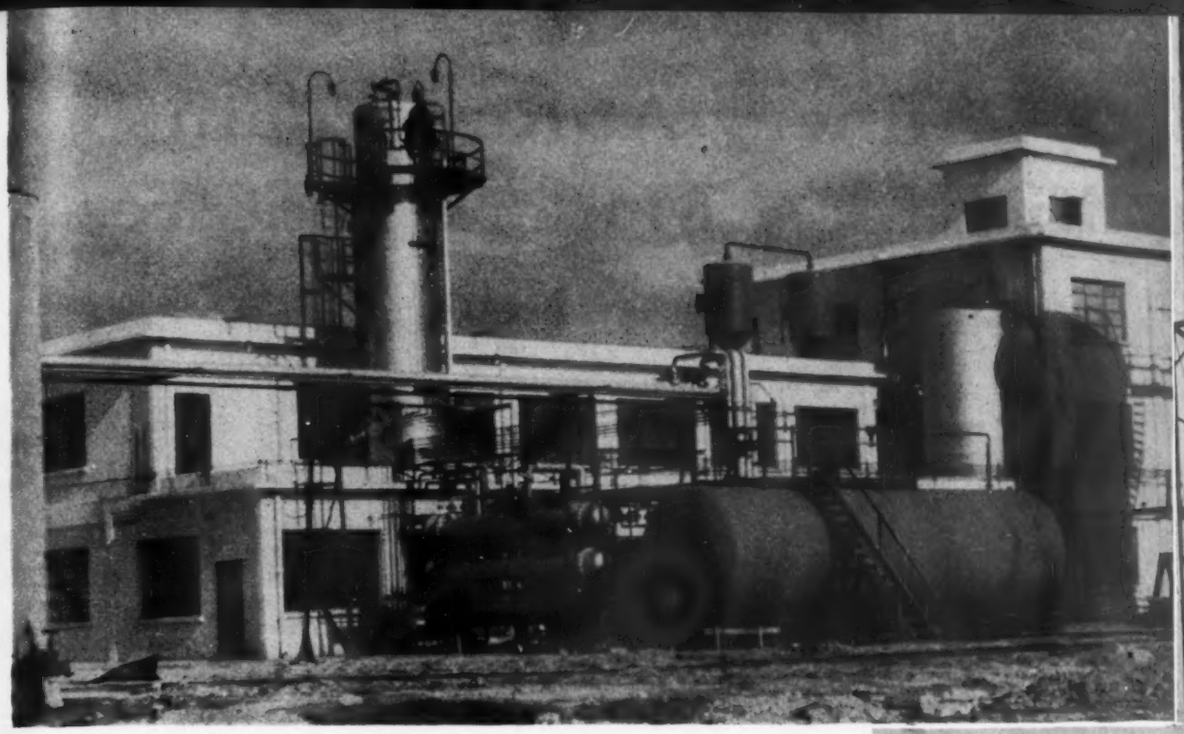
The refinery at Dunkerque will have a capacity of 33,000 B/D. Besides the topping unit from Courchelettes it will have the following units: a combined 26,000 B/D atmospheric and sub-atmospheric unit, units for redistillation of white spirit and for solvent rectification, separation of propane and butane, a unit for thermal reforming and stabilization, and a unit for chemical treatment of white products.

The lube plant will include units for deasphalting propane, refining furfural, deparaffining with methyl-ethyl-ketone, treatment of paraffine, unit for clay treatment; when installed, these units will have a capacity for about 380,000 barrels a year.

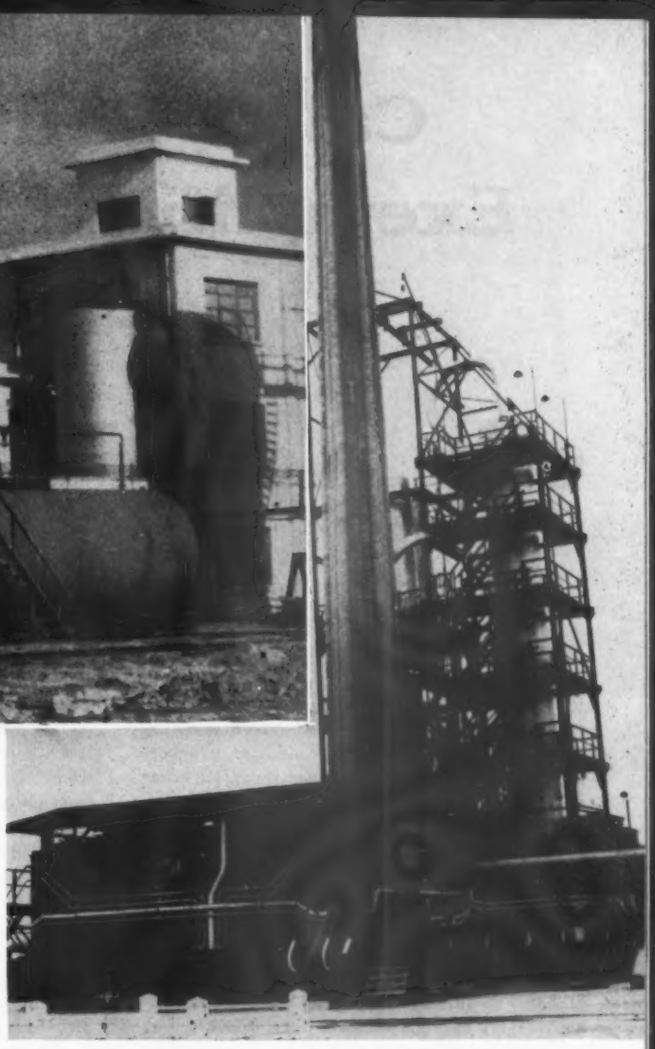
The bitumen plant will include units for preparing road and aglomerated bitumens and oxidized bitumens. Most of these units will be in operation in 1951.

The Raffinerie de Courchelettes has an installation for refining by the SO_2-benzol method, and will work on distillate products received from other refineries for manufacturing motor oils and bright stock. During

General view of Raffinerie d'Ambès situated at confluence of the Rivers Garonne and Dordogne near Bordeaux.



Lubrication unit, refinery of Socony-Vacuum Francaise at Notre Dame de Gravenchon.



Distillation unit of Raffinerie de Notre Dame de Gravenchon.

1949 about 41,000 barrels of lubricants were made. Besides this, the works at Courchelettes operated on important orders of material destined for Dunkerque and l'Avere.

Socony Vacuum Francaise has enlarged its Raffinerie de Notre Dame de Gravenchon by putting into service units for refining oils with furfural, for centrifugal deparaffining, clay treatment and vacuum distillation. The filter-press deparaffining unit was shut down in February 1950.

At the Raffinerie de Frontignan installations put in service were: a second 10,000 B/D distillation unit and a reforming unit. Work now in course includes modernization of the power plant where a first high pressure boiler and a first turbine will probably be put in operation during the summer of 1950; tank building; refitting and modernization of the No. 1 distillation unit (May 1950). Besides these modernization of the gasoline department will be effected during 1950.

In 1949 the first stage of reconstruction of the Raffinerie de Ambès of Raffineries de Petrole de la Gironde was virtually completed. It included revision and restoration to service of the power plant, construction of topping, reforming and re-run units; enlargement of storage facilities. The topping and the re-run units were put in service in February 1950, the reforming unit in March.

Among works now in course and to be finished in the next few months are improvement of wharfage facilities for crude oil tankers, lighters and coastwise shipping, and various constructions for general services.

The Raffinerie de Donges of Raffineries de Petrole de l'Atlantique put in service during the year two reforming furnaces and a new fractionating column, new storage capacity for 195,000 barrels. Other improvements were the remodeling and extension of loading platforms and the erection of buildings for workers' housing.

Improvements by Societe Anonyme d'Exploitation Miniere Pechelbronn at its Merkwiller plant comprise the installation of a combined atmospheric and sub-atmospheric distillation unit to be completed in the fall of 1950, modernization of the centrifugal deparaffining unit; completion of a unit for dehydrating crude oil; and general services: revamping of the steam lines and electric network and installation of a counter-pressure turbine. Work on the de-oiling of a sludge will be begun this year.

Distillation and reforming unit of Raffinerie de Frontignan.

TABLE I

	Barrels	Percent
Middle East—		
French participation in Iraq Petroleum Co.	7,865,500	8.8
Other origins	64,179,000	71.8
Western Hemis.—		
U. S. A.	488,800	0.5
Vénezuela	15,150,000	17.0
Other origins	1,217,300	1.4
Production of France proper	428,600	0.5
Total	89,329,200	100.0

TABLE II

Output of the French refineries June 1, 1949, to May 31, 1950

Propane	5,469 metric tons
Butane	89,670 "
Gasoline	23,349,160 barrels
White spirit	286,110 "
Jet fuel	97,550 "
Kerosene	1,992,610 "
Gasoil	19,749,100 "
Distillates and residual fuels	30,177,700 "
Lubricants	1,583,270 "
Asphalt	531,390 metric tons
Paraffin Wax	7,440 "
Petrolatum	1,607 "
Miscellaneous	337,140 barrels

Caltex Refinery At Rotterdam Exemplifies Most Modern Features Of Construction

By H. B. NICHOLS,
Vice President and Director, Caltex

ONE of the highly efficient and highly interesting of the refineries which have come into existence in Europe since the late war is that of Caltex Petroleum Maatschappij (Nederland) N.V., affiliate of the California Texas Oil Company Ltd., at Pernis on the outskirts of Rotterdam, Holland, and within the port area of that city. It is interesting because it is part of a great development program which the people and the business interests of the Netherlands are carrying on to build anew on broad and progressive lines a city that was nearly destroyed at the beginning of the war, and to make it one of the leading ports of the European continent.

This refinery is interesting for another reason. Having been designed and wholly erected within the past three years, it has been possible to incorporate in it the most advanced ideas as to arrangement, equipment and processing and to take advantage of numerous improvements that were brought out during the war and in the immediate postwar period. Most refining plants represent a gradual growth over a longer or shorter time. As new units are added, they have to be fitted into the original framework as may best be done. In this case, however, the plant was newly built from the ground up—literally so, as the very soil on which it stands had to be supplied, a factor which presented some special problems to its constructors.

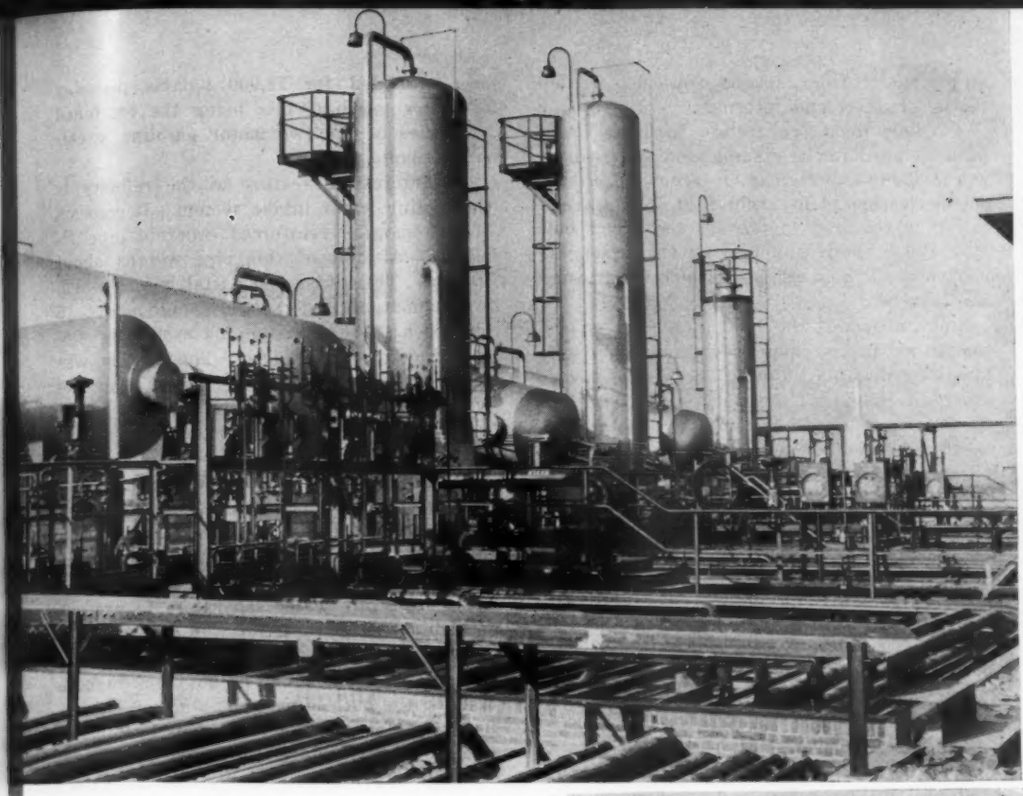
The refinery is located in what the Dutch authorities call the Second Petroleum Harbor. The section which, like much of Holland, was formerly below water level, is now a filled-in area that is being converted into a great industrial district. The refinery site itself consists of a little over 100 acres lying along the bank of the Nieuwe Maas River, the most important of the outlets of the Rhine emptying into the North Sea. It was formerly a marshy morass, and to make it fit for use, it was necessary to pump in thousands of tons of sand from the river bed. This procedure was undertaken as part of the general plan of harbor development, and the final pumping in of sand was completed early in 1947.

Because of the nature of the soil which has no bearing value, it was necessary to support all of the refining equipment and most buildings on pile foundations. The piles used were precast reinforced concrete in columns 14 inches square and varying in length from 30 to 100 feet. For piles over 75 feet long special rigs for handling and driving had to be designed and constructed. A total of 2,400 piles were precast on the site and driven. Although the area was carefully drained, the settling process of the soil is expected to continue very gradually over a period of years, and that had to be taken into account in planning the structures not supported by concrete piers.

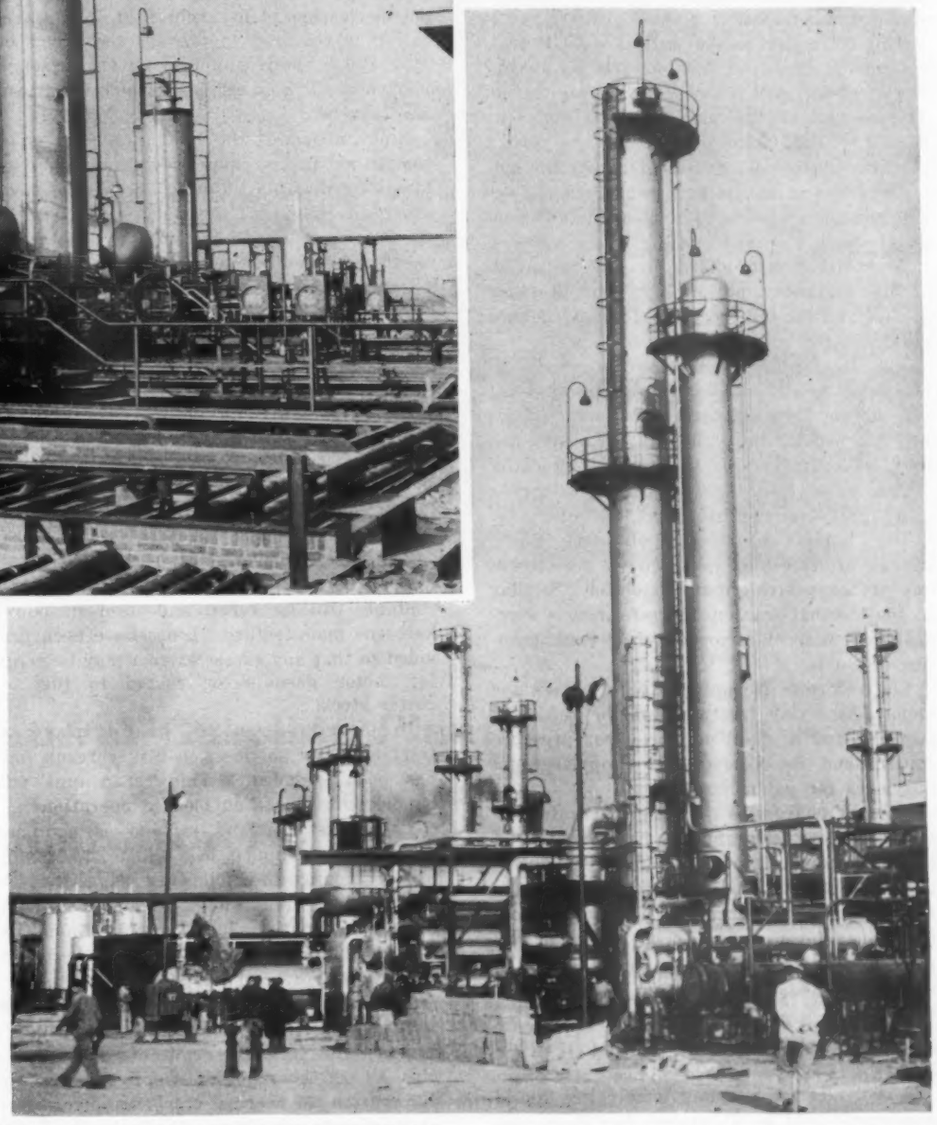
It may be worth mentioning that this new refinery has been built entirely with private capital supplied by its owners. Although Netherlanders sometimes refer to it as "the little Marshall plan," it was planned and started before ECA came into operation, and it may be regarded, therefore, as an outstanding example of the possibilities of American investment for the development of industry in other lands where such undertakings are welcomed, as in this case where the Netherlands government extended its full cooperation.

Construction of the plant was begun by Arthur G. McKee & Co. after clear-

General view of Caltex Pernis refinery showing, from left to right, crude distillation unit, thermal cracking plant, SO_2 and other treating facilities, power plant and cooling water pumping facilities. Offices, warehouses, laboratories, machine shops and dwellings are seen at the upper left of the photograph.



General view of sweeting plant.



Exchangers and fractionating columns during construction of the thermal cracking plant.

ing of the site and completion of the groundwork in 1947. It was designed to process 20,000 barrels daily of Arabian crude and to produce motor gasoline, illuminating kerosene, power kerosene, automotive and industrial diesel oils and fuel oils. In general the operating units consist of a two-stage atmospheric-vacuum crude distillation unit, thermal cracking and reforming equipment for the production of motor fuel, an SO_2 treating plant for the manufacture of high quality illuminating kerosene, a polymerization plant for the conversion of unsaturated cracking and reforming gases to motor gasoline polymers, a small utility rerun unit and auxiliary sweetening, inhibiting and ethylizing facilities. In addition to the actual process units, facilities have been provided for the generation of process steam, the supply of refinery cooling water, the shipment of finished products by barge, tank car and tank truck, laboratory control testing, administration, fire and safety control, employee services, including a cafeteria and change house and maintenance of refinery equipment. There is a central power plant and the usual auxiliary facilities including a nearby housing development for the use of employees.

The various process units may be described more in detail as follows:

The crude distillation unit has been designed for a daily throughput of 22,500 barrels. This capacity provides for 20,000 barrels per day employing a conservative operating factor of 90 percent.

The atmospheric and vacuum columns of this unit have been designed to separate crude oil into fractions consisting of one whole gasoline cut, one kerosene distillate, one cut each of light, medium and heavy merchantable diesels, a heavy waxy gas oil and residuum. Minimum residuum yield has been established at nine percent of crude, a low yield in order to provide a satisfactory supply of heavy waxy gas oil for thermal cracker charge stock, and to permit production of low pour-point fuel oils. Process design calculations demonstrated that such a low residuum yield was attainable in a two-stage distillation system without excessive equipment sizes.

The several diesel and gas oil cuts were selected in view of the considerable range of diesel and gas oil products required in Holland and Belgium. It is anticipated that the heavy waxy gas oil production will be regularly charged to the thermal cracker, but other diesel distillates may be routed to either cracker charge or diesel blending, depending on the stock situation and market demands at any particular time.

The crude distillation unit is equipped with naphtha rerunning facilities to separate light straight-run naphtha for direct sweetening and blending into motor gasoline. Normally the rerun column bottoms will be charged to the thermal reformer, but provision has been made for producing a heart cut heavy

An important phase of the building of the new refinery was the training of local operating personnel.

gasoline for the manufacture of tractor power kerosene.

A stabilizer is provided for debutanization (or depropanization, dependent upon finished gasoline vapor pressure demands) of the light straight-run naphtha.

The thermal cracking unit is a UOP two-coil unit designed for 7,500 barrels per stream day of 20-25° API heavy waxy gas oil charge. The design of the unit provides sufficient flexibility and latent overcapacity to permit the refinery to meet greater demands for motor gasoline or to absorb higher than the design volume of gas oil into gasoline and fuel oil products.

A stabilizer is provided for debutanization of the cracked naphtha for vapor pressure control and for the recovery of propylene and butylenes for polymerization.

The unit is designed to produce a 400°F maximum ASTM end-point motor gasoline and a residuum (cracked tar) suitable for blending into merchantable fuel oil. Provision has been made for varying the depth of cracking over a reasonable range to assist in balancing overall refinery operations.

The thermal reformer is of UOP design, capable of processing 7,000 barrels per stream day of heavy straight-run naphtha. Similar to the thermal cracker, the reformer is over-designed to meet abnormal short-term gasoline demands.

The reformer is equipped with towers for vapor phase clay treatment of the reformed naphtha and a stabilizer for vapor pressure control and the recovery of propylene and butylenes for polymerization.

Normal charge to the thermal reformer will be heavy straight-run naphtha (rerun column bottoms from the crude unit) of approximately 35 CFRM clear octane. The design of the unit incorporates adequate flexibility in reforming severity to permit variation of the product octane number over a reasonably wide range up to approximately 70 CFRM clear octane. The small yield of reformer tar will be disposed of in fuel oil blending.

A polymerization plant employing liquid phosphoric acid as a catalyst has been provided to convert propylene and butylenes from the thermal cracking and reforming units to motor gasoline polymers. The unit has been sized to handle the maximum combined olefin production from capacity operations of the thermal cracker and reformer.

Auxiliary feed preparation facilities have been included for de-ethanization and hydrogen sulfide and mercaptan removal of the polymerization plant olefin feed. De-ethanization is required to prevent the formation of a stable ester, produced by the action of phosphoric acid on ethylene, which inactivates the catalyst.

Stabilization of the reactor effluent is accomplished in two steps, depropanization followed by debutanization. The depropanizer overhead provides "sweet" propane gas for the refinery fuel gas system; the debutanizer overhead provides "sweet" butane for vapor pressure control of motor gasoline.

An SO_2 treating plant of the Edeleanu type has been provided for the removal of aromatics and sulfur from kerosene distillate in order to produce high quality illuminating kerosene. It is anticipated that this illuminating kerosene will meet British jet fuel specifications. Excess capacity has been incorporated in the SO_2 treating plant to give the refinery a reasonably high degree of flexibility in kerosene or jet fuel manufacture.

The SO_2 treating plant extract, relatively high in octane rating due to its aromatic content, will be rerun and used in power kerosene manufacture. Lines have been provided so that any excess extract may be rerun for motor gasoline or routed to fuel oil cutter stock.

In order to rerun SO_2 treating plant extract and raw polymers, a utility rerun unit has been included. This rerun unit will handle both stocks on blocked operations.

The Caltex Holland refinery is equipped with three continuous lead sulfide sweetening plants having the following capacities, in barrels per stream day: light straightrun, reformed naphtha, 7,000; cracked naphtha, 4,000; illuminating and power kerosene, 2,050.

The gasoline sweetening plants have been sized to sweeten the normal light straight-run naphtha from the crude distillation unit plus all of the naphtha which can be produced from the thermal cracker and reformer at maximum capacity. Similarly the kerosene sweetening plant has been sized to sweeten the anticipated maximum production of kerosene or power kerosene.

Inhibiting and ethylizing facilities have been provided for 11,000 barrels per day of motor gasoline, this being the combined capacities of the two motor gasoline sweetening plants.

An interesting feature of the refinery is the cooling water intake system. It consists of two parallel reinforced concrete pipe siphons. A joint of this pipe weighs about 10 tons. The intake and outfall pieces which are submerged under water weigh about 15 tons each. The entire piping system is supported on concrete piles. The system was designed for siphoning the water over the dikes which protect the site, since it is not permitted to break through the dikes.

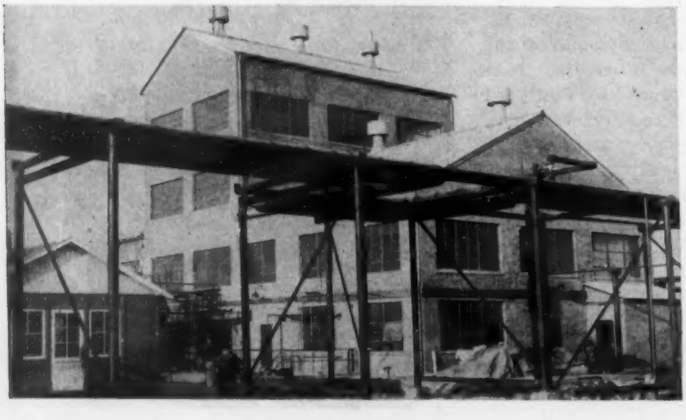
The water is received in a fore-bay in which are located two sets of self-cleaning screens. The water flows through these screens into the suction pits for the cooling water pumps which distribute the water to the refinery. Refinery waste goes through extra large oily water separators to prevent contamination of the river water.

Two reinforced concrete wharves provide facilities for unloading crude from tankers and for the outloading of products. The refinery is intended to serve markets in Holland, Belgium and western Germany, and much of its distribution will be over internal waterways, rivers and canals. To maintain a constant supply of crude for the refinery, a fleet of ocean-going tankers is being put into service with a schedule providing for the delivery of a cargo every fourth day.

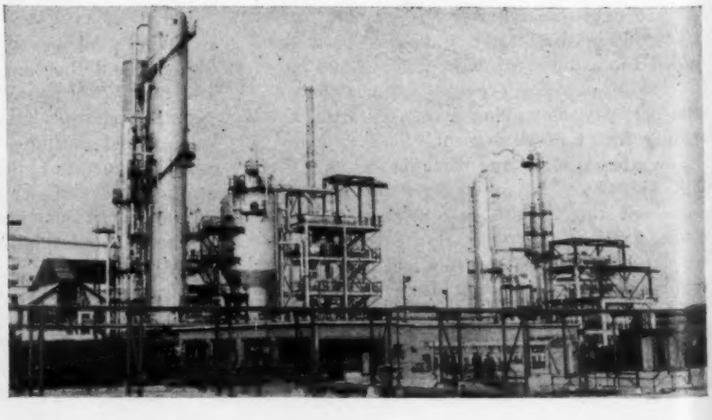
Completed at a cost of $26,000,000, the refinery was formally opened on May 12 by the Netherlands Minister of Economic Affairs, N. R. M. Vandenbrink. In his address the Minister said in part:

"The completion of this refinery is a sign of the growing significance of Rotterdam as an important sea and transport point. It is of national importance as a contribution to the industrialization of this country which is so much needed. I am convinced that the confidence in the economic position of the Netherlands shown by the management of the Caltex Petroleum Company will not be in vain. In this field cooperation with other countries is desirable, not only for increasing our technical knowledge and strengthening industrial finance, but also for promoting international cooperation in general without which the economic outlook for our part of the world would be extremely gloomy."

Building housing the SO_2 treating plant.



20,000-barrel crude distillation unit.



Process area with Hudson direct air condensers in foreground. All photographs by Elwood Payne, Houston.

SEELIGSON Natural Gasoline Plant

World's Largest In Compressor Horsepower

THE natural gasoline plant in the Seeligson field in South Texas, representing the largest concentration of compressor horsepower of any such plant in the world, is the largest processing plant of its kind and has the most complex cycling program.

The Seeligson field, discovered in 1937, lies in the more or less continuous Agua Dulce-La Gloria trend, often ranked as the country's greatest gas and condensate reserve as well as a source of crude oil second only to east Texas. Continuous production in the Seeligson field extends under some 16,000 surface acres in Kleberg and Jim Wells counties, with a total of more than 90,000 reservoir acres. Gas and oil wells have been completed in a total of 39 distinct producing zones or reservoirs.

The natural gasoline plant, on a 67-acre site, provides full utilization of casinghead gas and produces considerable quantities of liquid petroleum products from casinghead and cycle gas. It is jointly owned by thirteen participating oil companies: Magnolia Petroleum Company, which operates the plant, Dunlap Oil Company, Ramsey Petroleum Company, Renwar Oil Corporation, Republic Natural Gas Company, W. A. Richardson et al, W. A. Richardson Oil Company, Shell Oil Company, Sinclair Oil & Gas Company, Sun Oil Company, Sunray Oil Corporation, Texas Gulf Producing Company and the Underwood Mineral Company.

The plant was constructed by the Hudson Engineering Corporation, starting in 1947 after four years of intricate effort by the participating oil companies to unitize the gas reserves of the field. The unitization, now signed by about 98.5 percent of the affected royalty owners, became effective July 1, 1948, nearly six months after the plant opened for initial operation. Unitization in this field covers all gas except that produced directly with oil.

The Seeligson plant has proceeded through four separate stages to reach its present operational status. In January 1948 the first three Clark 1600-hp reciprocating compressors went into operation to compress casinghead gas from the field. By mid-March of that year eight compressors were in operation, and the plant was able to handle all the casinghead gas from the participating area. The compression and cooling of the gas yielded from 10 to 12 thousand gallons of No. 14 natural gasoline daily with field separator pressure about 20 psig.

Installation of two Ingersoll-Rand 36,500 cfm centrifugal compressors of 4,200 hp each later in 1948 added a fourth low-pressure stage to the system compressing casinghead gas from 10-inch Hg. vacuum suction to 1,050 psig discharge. The residue gas after processing and dehydration is delivered to Tennessee Gas Transmission Co. at about 950 psig. These six-stage centrifugal compressors, operating in parallel, were the first such to be installed in a natural gasoline plant. These compressors take suction at a vacuum up to 10-inch Hg. They discharge to the reciprocating compressor master suction header at pressures up to 37 psig. The compressors are driven by impulse-type steam turbines using steam from 600 psig and 825°F to 28-inch Hg. vacuum condensation.

The centrifugal compressors were installed primarily to effect considerable economy in both investment and operations. In spite of their greater size per unit, each equivalent to 2.25 of the 1,600-hp Clarks the centrifugals have a wider range of flexibility with varying volumes and suction pressures than do the fixed displacement reciprocating units. After the centrifugals were put in service, the field separation pressure was dropped to atmospheric and the plant production by compression nearly doubled.

By early 1949 the centrifugal compressors were handling up to 35,000 pcf of gas a day, with No. 14 natural gasoline still the only liquid petroleum product being recovered in quantity. In September 1949, however, processing was initiated with subsequent recovery of such liquid products as propane, isobutane, normal butane and natural gasoline.

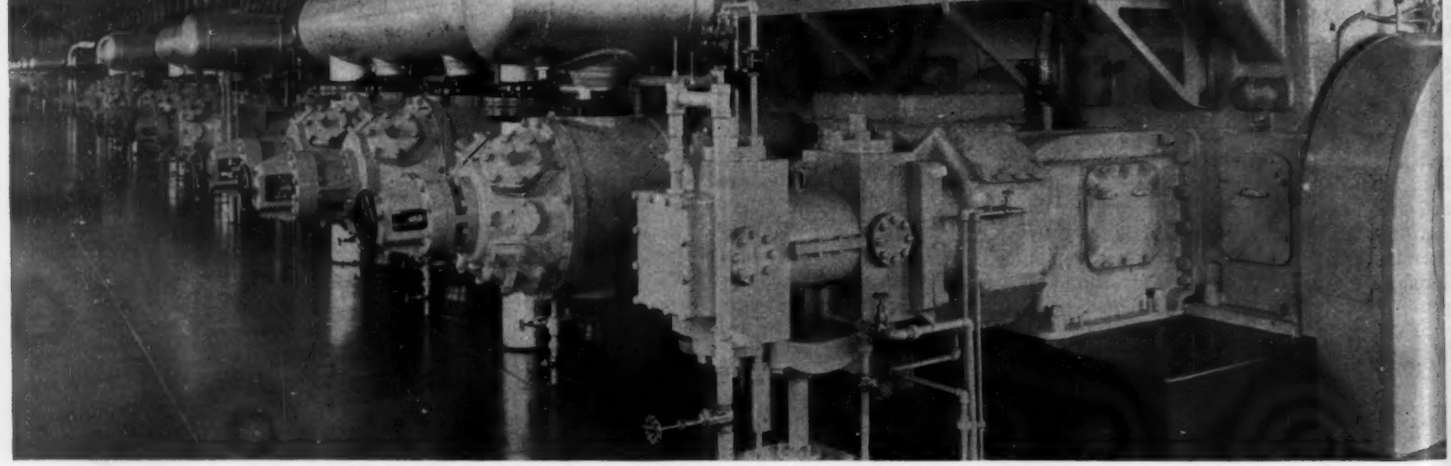
The plant entered its fourth phase, the last currently planned, in March 1950 when the cycling system went into operation. The plant now includes 12 Clark reciprocating

Aerial view of Seeligson natural gasoline plant.

compressors of 1,600 hp each, which, with the two 4,200-hp centrifugals, gives Seeligson a total compressor capacity of 27,600 hp. Plant products now include motor fuel base, kerosene, absorption oil and residuum.

The casinghead gas from 664 participating oil wells and the cycle gas from fifteen gas wells is providing a daily input of about 98,000 mcf, with cycle gas accounting for about 72,000 mcf of the aggregate. A little over 23,000 mcf a day of residue gas is delivered to the lines of the Tennessee Gas Transmission Co., 2.7 miles from the plant proper. Due to proration, casinghead volume is off about 50 percent. Cycle volume is less than design

Interior of 572-foot-long compressor room with twelve 1600-hp Clark compressors and two 4200-hp Ingersoll-Rand turbo-compressors.



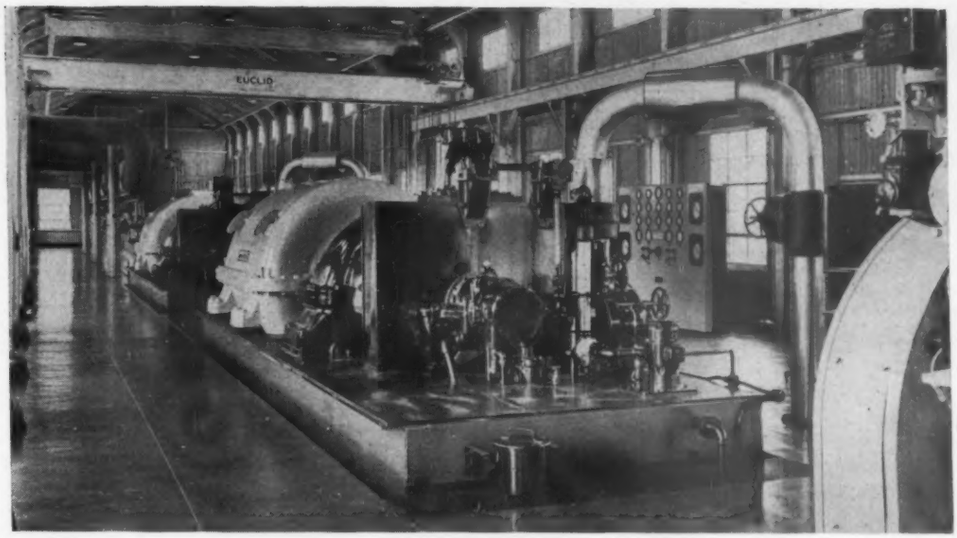
due to cycle pattern. En route to TGT's lines, the gas is dehydrated and then subjected to metering, a recording gravitometer and a Btu recorder, before entering the lines at a pressure of 950 psi. Nearly 64,000 mcf of cycle gas daily is being injected through five injection wells at a pressure of 3,450 psi and metered to maintain zone balance.

Daily production of No. 9 gasoline is running around 94,000 gallons; of propane, about 44,000 gallons. Isobutane accounts for a little over 17,000 gallons daily; normal butane, around 18,700 gallons. Kerosene production averages around 4,000 gallons daily, mineral seal oil close to 1,200 gallons, and residuum almost 1,400 gallons. These production rates are, of course, at current gas volumes.

Primarily built for the conservation and utilization of gas produced from the Seeligson field, the plant's greatest long-range value may, however, lie in the ultimate crude oil recovery it makes possible. Its profitability is further enhanced by the shallowness of pay zones. Oil has been found at depths ranging from 4,609 to 7,233 feet; gas condensate from 4,493 to 7,223 feet.

The oil reserves participating in the Seeligson plants are not yet being repressured, since reservoir pressure continues to be satisfactory, but the presence of repressuring facilities is certain to bring greater ultimate recovery of the crude oil. Gas lift service is being furnished to nearby oil well leases.

The casinghead gas gathering system includes 242,888 feet of pipe, ranging from two through 24 inches. The casinghead residue system totals 94,222 feet of pipe from two through six inches. The cycling system embraces 45,639 feet of pipe from three through 12¾ inches, while the footage of the injection system runs to 30,035 feet of pipe from four through eight inches. Additional pipe systems carry liquefied products to rail and motor heads, where adequate loading facilities have been constructed. Pipeline outlets are also available.

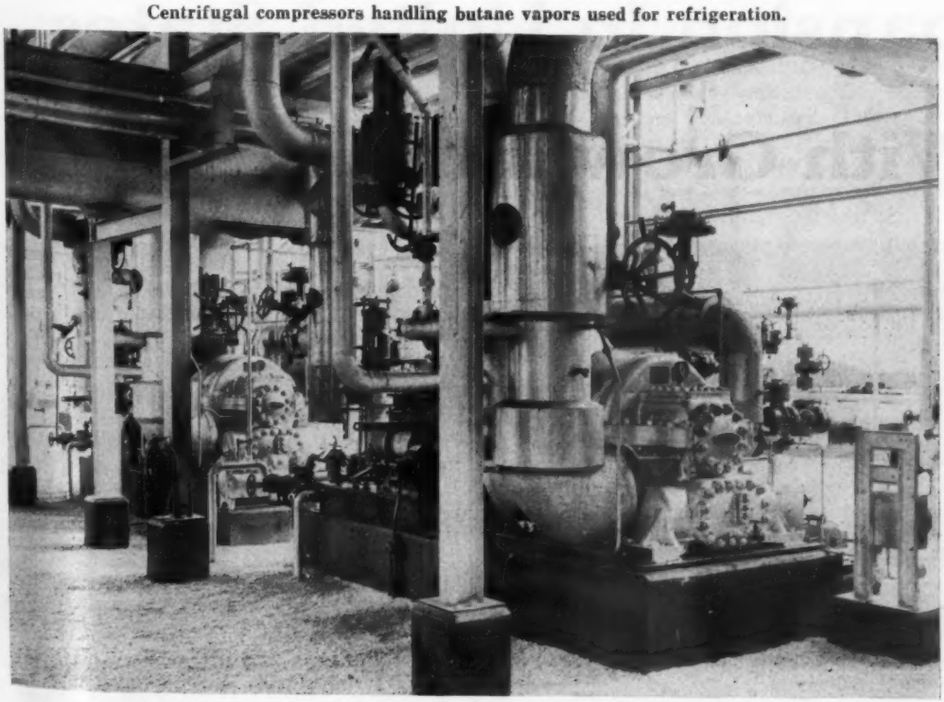


Centrifugal compressors handling low pressure gas.

Water used in the large cooling system comes from four wells drilled on the plant site to about 2,400 feet. The water is extremely soft and requires treatment to counteract carbonates and corrosion. Waste water is returned through two disposal wells at 3,100 feet. Since the plant is located in flat ranch country with little surface drainage, waste water has to be treated through a waste water disposal plant and pumped into salt water sands. Water disposal rate is currently running around 140 gallons a minute or about 200,000 gallons daily.

The use of Sovabead, a Socony-Vacuum dessicant, in one of the plant's three gas dehydrators has been successful. Activated alumina is being used in the other two dehydrators which were original units. The regeneration and cooling cycle requires eight hours each with two towers in parallel drying service all the time. Time-cycle controllers switch the towers automatically.

Centrifugal compressors handling butane vapors used for refrigeration.



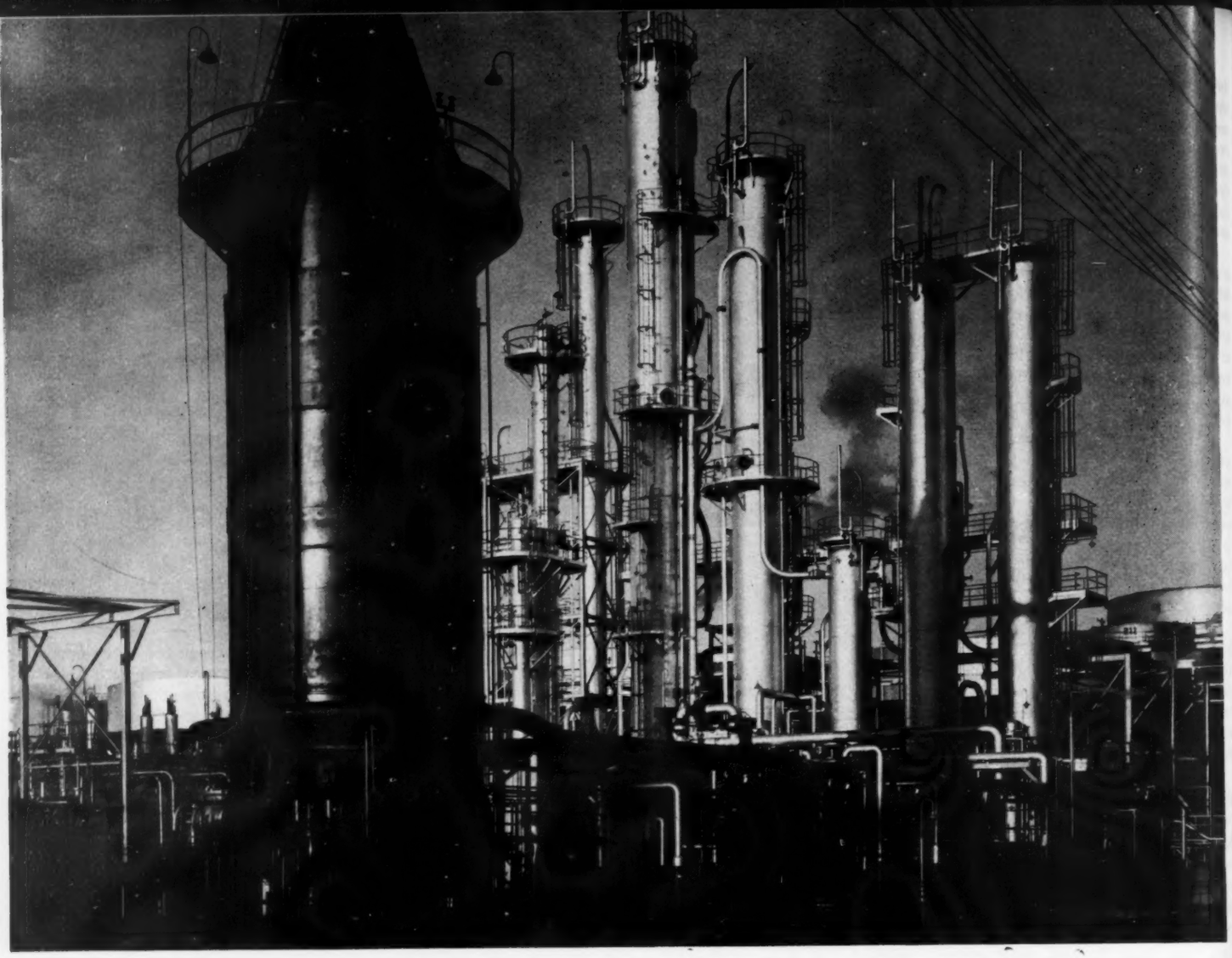
Seeligson has ample storage facilities for its liquefied products, based on five-day supply, although the current seasonal slump has somewhat aggravated the problem of storing propane and butane. Consumption of liquefied gas rose 8.5 percent in 1949 to nearly two and three-quarter billion gallons, but this is well under the 25 to 40 percent rate of growth in prior years. And the increase in natural gasoline plants such as Seeligson has tended toward at least a temporary over-supply of these products.

The complexity of the ownership of the Seeligson plant by the thirteen partners, the interest of some of them being calculated to six decimals, makes bookkeeping almost as big a job as plant operation. The plant contains over 300 accountable meters and a staff section working with integrators calculating meter readings. Both casinghead and cycle gas are measured at almost every step of their progress through the plant. Also the GPM content of all field gas is measured quarterly.

Key personnel employed in the plant are housed in 20 homes, built by the thirteen participating companies on a sizable site in the nearby city of Premont. The camp is equipped with many recreational facilities. All homes are on a rental basis.

The actual month-to-month profitability of such a plant as Seeligson will probably have to be reckoned more on the basis of hindsight at some future date than on any basis of current operations. But the economic benefits expected to accrue, as distinguished from immediate dollars and cents calculations on sale of residue gas and liquefied products, are considerable. They may, in fact, well prove to be enormous. This plant, conserving gas and extracting liquid products as it does, is making more petroleum products available to the participating companies and thus, of course, to the public.

Many oil men also believe that the size and character of this installation go a long way to sketch in the shape of things to come in natural gasoline plants. The trend now, many of them believe, will be toward larger unit—not necessarily on the scale of Seeligson but nevertheless considerably larger than many such plants in the past.



Crude distillation unit at Oleum refinery of Union Oil Co. of California.

Refinery Expansion In United States Keeps Pace With Growth In Demand

THE past year, 1949-50, has been marked by steady progress in the expansion of refining facilities in the United States which has increased daily capacity by 25 percent since the beginning of 1947, from 5,400,000 to roundly 6,750,000 barrels on July 1, 1950. Additions during the latest twelvemonth period may be considered as the normal growth needed to satisfy the country's rising requirements and to maintain a safe reserve sufficient to meet emergency demands. Projects under way and scheduled for completion in late 1950 or 1951 indicate that the current rate of yearly expansion of five to six percent is likely to continue.

Along the Atlantic Coast the trend of development has been marked by new construction and enlargement of existing plants that have added materially to processing capacity in that section. A notable entry into this field was that of the Eagle Point works of the Texas Company at Westville, New Jersey, on the Delaware River, which was formally dedicated in December last. This plant of 40,000 barrels daily charging capacity includes a crude distillation unit designed and built by Foster Wheeler Corporation, a fluid catalytic cracking unit of 25,000 barrels daily capacity engineered by the M. W. Kellogg Company, a furfural plant of original design which is described in detail in another article on other pages of this issue, a thermal reforming unit and the other equipment usual to a complete refinery.

Transformation of the Bayonne, New Jersey, plant of Esso Standard from a general refinery to a specialty plant producing lubricating oils, waxes and asphalt has been completed during the year. The modernization program at Bayonne has included the construction of a power plant with boilers producing 400,000 pounds of steam per hour and installation of an MEK unit designed to manufacture 178 million pounds of wax annually besides lubricating oils and asphalt. The plant, which was formally dedicated in May of this year, also has facilities for the blending of aviation gasoline and other products. Through its pipe line connections with the nearby Bayway refinery of Esso Standard the two are able to function as a

combined manufacturing entity. Recent additions to Bayway have included a vacuum still of 49,000 barrels daily capacity and a 41,000 barrel fluid catalytic cracker, two of the largest units of their kinds in any refinery.

At Paulsboro, New Jersey, a crude distillation unit of 19,500 barrels daily capacity and a furfural refining and contact filtration plant constructed by E. B. Badger and Sons Company have been added to the refinery of Socony Vacuum Oil Company. Other new features designed by the same engineering firm which are being added to Paulsboro during 1950 are a light oil treating unit of 28,000 barrels daily capacity and MEK dewaxing and propane deasphalting installations. An engineering change made at the Paulsboro plant involves the raising of the pipeways system from its underground position to an elevation ranging from 18 inches to 25 feet above the surface. The change affects 6,330 feet of lines and its advantages include lower maintenance costs and greater ease in rearrangement of piping, installation of new connections or substitution of one line for another. Some 75,000 feet of lines are mounted on the pipeways and include conveyors of water, steam, crude oil, fuel oil and air. Water lines for processing purposes together with ducts for electric wires and conduits for fire foam remain underground.

Sun Oil Company earlier this year added to the facilities of its refinery at Marcus Hook, Pennsylvania, a six million dollar blending, packaging and warehousing plant. Approximately seven acres of floor space are under roof at this plant and a mile and a quarter of conveyor lines eliminate all but a small fraction of manual labor.

At the Atlas plant of Socony Vacuum at Buffalo, New York the fixed bed catalytic unit has been replaced by a TCC unit of 15,000 barrel capacity. A catalytic polymerization unit is being added and gas recovery facilities expanded. The construction work is being performed by Bechtel Corporation.

Kendall Refining Company is preparing to install a platforming unit in its refinery at Bradford, Pennsylvania*. Designed, engineered and constructed by Universal Oil Products Company the unit will charge 1500 barrels per day of low-grade Pennsylvania straight-run gasoline to produce motor fuel of high quality. The plant is expected to go into operation by the end of this year.

Two-stage distillation tower in Pure Oil Company's new lube plant at Nederland, Texas.

A noteworthy reconstruction task which amounts to the establishment of a new refinery is being carried forward by the California Refining Company at Barber, New Jersey. It includes the installation of a crude distillation unit of 50,000 barrels daily capacity, a Houdriflow catalytic cracking unit of 25,000 barrels daily capacity, a 10,000 barrel reforming unit and a power plant with boilers developing 300,000 pounds of steam per hour, all being erected by C. F. Braun & Co. An alkylation unit is being supplied by The M. W. Kellogg Co. and gasoline and sweetening units by Catalytic Construction Co.

Standard Oil Company (Ohio) is bringing toward completion a $29 million program of construction at Lima, Ohio. The program consisted of three parts, a fluid catalytic cracker, a combined crude treating and coking unit and a lubricating oil unit. The fluid catalytic cracking installation of 16,000 barrels daily capacity is of UOP design and was built by Arthur G. McKee & Co. The crude-coker installation designed by The M. W. Kellogg Co. has some unusual features including the use of a common fractionating tower for both the crude and the cracked decoker products and a blowdown system to recover waxtailings during the steaming of the coke drums.

The lubricating oil plant includes vacuum distillation, solvent deasphalting, solvent extraction, solvent dewaxing and clay treating units, all engineered by The Lummus Company with the exception of the deasphalting equipment which is supplied by The M. W. Kellogg Company. The lube plant will process 9,000 barrels daily of reduced crude. Its circulating reflux system is designed for complete condensation of all hydrocarbon reaching the top tray; the overhead gas oil product is taken from the circulation reflux line. A new type shower tray developed by The Lummus Company is being used in the towers.

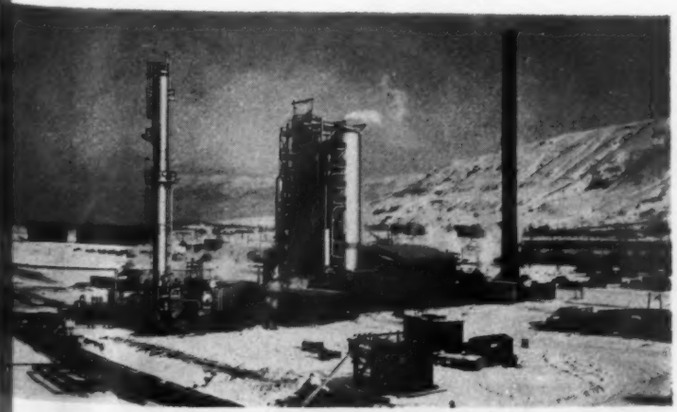
Replacement of the fixed bed catalyst cracking unit in the Cleveland, Ohio, plant of Sohio by a TCC unit of 19,000 barrels daily capacity is being made by Bechtel Corporation. Engineering work on the project was begun early in the year and is due for completion by next December. Installation of TCC units of 15,000 barrels daily capacity at Socony Vacuum's refineries at Trenton, Michigan, and Augusta, Kansas, to replace the fixed bed catalyst method formerly employed is now in progress and is scheduled for completion late in the present year. The work at Augusta is being conducted by Fluor Corporation and that at Trenton by C. F. Braun & Co.

At Mount Vernon, Indiana, the refinery of Indiana Farm Bureau Cooperative Association is being enlarged by addition of a vacuum unit, a UOP fluid catalytic cracking and gas concentration unit, and a UOP catalytic polymerization unit. The catalytic cracker is designed for a capacity of 3,400 barrels per day of vacuum gas oil and atmospheric gas oil and distillate. The crude throughput of the plant will be approximately 8,000 barrels per day estimated to yield 70 percent total gasoline when the units are operating for maximum gasoline production. Completion of the installation is scheduled for the final quarter of this year.

At Blue Island, Illinois, Petco Corporation is adding to its plant a Houdriflow cracking unit of 5,000 barrel capacity and an LPG recovery installation. Construction is by Catalytic Construction Company and completion is scheduled for the final quarter of 1950.

In this midwest area Sinclair Refining Company has added to its capacity by the simple means of purchasing The Wood River Oil and Refining Company with a thoroughly modernized plant at Wood River, Illinois.

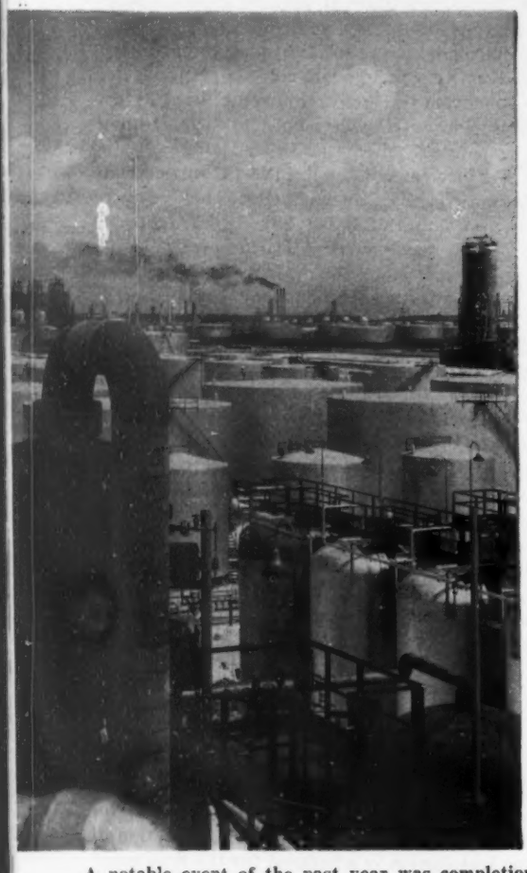
* The Platforming process was described in connection with its first installation in the plant of Old Dutch Refining Co. at Muskegon, Michigan, in WORLD PETROLEUM, April 1950.



Main crude unit completed by Salt Lake Refining Co. before catalytic cracking unit was installed.

Three new units at Bakersfield refinery of Standard Oil Co. of Calif. Left to right: crude unit, cracking unit and Unisol plant.

Further West at McPherson, Kansas, the National Cooperative Refinery Association is installing new units consisting of a 9,800 barrel fluid catalytic cracker of UOP design and an 880 barrel UOP polymerization unit. Construction is being handled by Refinery Engineering Company. Cost of the additions is an estimated three million dollars and the revamped plant is expected to go into service about April, 1951.



Shallow Water Refining Company at Garden City, Kansas, has installed a Perco reforming unit of 1,400 barrel capacity engineered by Koch Engineering Co. and at Cheyenne, Wyoming, Frontier Refining Company is adding to its plant two UOP coke cracking units built by Refinery Engineering Company.

Phillips Petroleum Co. is continuing its refinery expansion and modernization program at its two major refineries at Kansas City, Kansas, and Phillips, Texas. Plans now are being prepared for the installation of a 10,000 barrel crude still at Kansas City. Construction will be begun later this year. When this new still goes on stream in 1951 the plant will have a crude capacity of 60,000 barrels daily.

A year ago Phillips completed a new lube plant at Kansas City and shut down the older lube plant at Okmulgee, Oklahoma. In early November the catalytic polymerization unit at Kansas City went on stream and a few days later a 12,000 barrel vacuum still for cracking feed stock was ready for operation. The 30,000 barrel catalytic cracking unit went on stream in February this year.

The present building program at Phillips, Texas, will not be complete for another year. Except for lube production the Texas plant will be similar in capacity and other facilities to the Kansas City refinery. Crude capacity will be increased 20 percent to 60,000 barrels daily. A 12,000 barrel vacuum still will be built to provide feed stock for a new 30,000 barrel cat cracker. Strides are being made currently of the desirability of solvent extraction of cracked cycle stocks for the production of high diesel index fuels. The engineering department of Phillips is designing and building the vacuum stills and C. F. Braun and Co. is building the catalytic cracking unit.

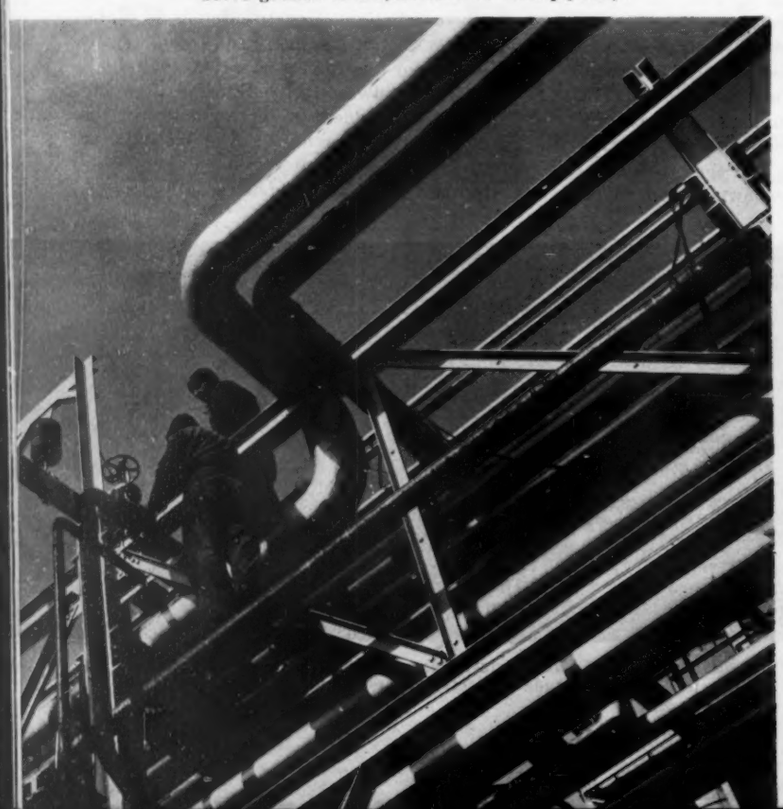
Bell Oil and Gas Company has announced that it will shortly begin construction of a new unit to be added to its refinery at Grandfield, Oklahoma. The unit, designed and engineered by Universal Oil Products Company, will embody the Platforming process recently developed by UOP which employs a platinum containing catalyst for reforming low grade gasoline into high octane motor fuel. The Platforming unit will have a charging capacity of 1,500 barrels per stream day of mixed straight run and cracked gasoline and is expected to be in operation before years end.

At Drumright, Oklahoma, the Tide Water Associated Oil Company has just put into service a Houdriflow catalytic cracking unit of 4,500 barrels daily capacity built by Process Engineers and at Cushing, Oklahoma, Deep Rock Oil Company has installed a 5,000 barrel cat cracker of UOP design built by the Engineering Department of Jones & Laughlin Supply Co. Pan American Southern Corporation at El Dorado, Arkansas, is adding a delayed coking unit, water cooling system and power plant of 9,300 barrels capacity, engineered and constructed by The Lummus Company.

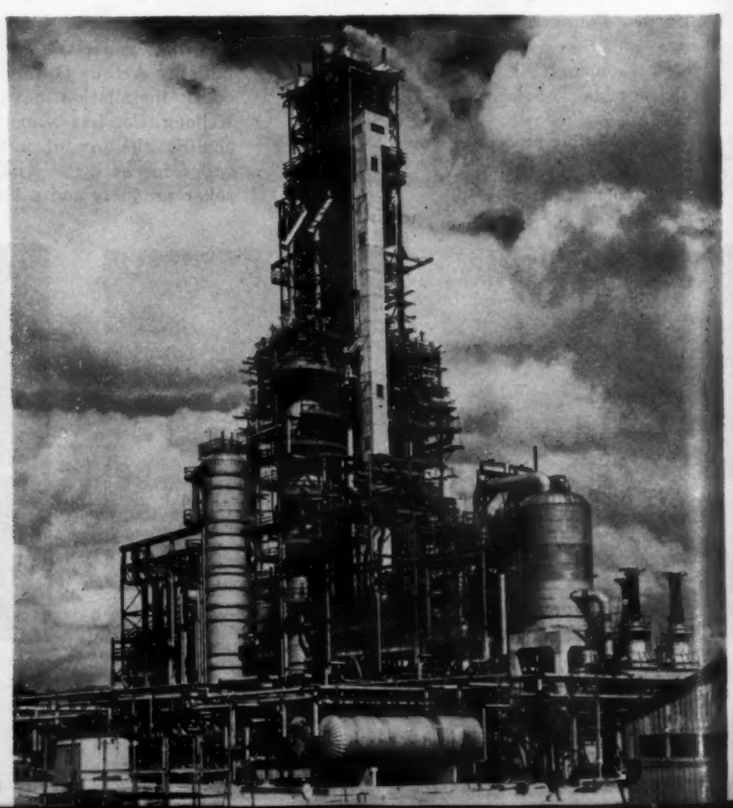
Along the Gulf Coast a notable event of the past year was the completion of the $42 million Cit-Con plant of Cities Service Company and Continental Oil Company at Lake Charles, Louisiana, which was officially opened last December. The refinery converts 6,000 barrels daily into lubricants and waxes out of its feedstock of 18,000 barrels. Its furfural unit is the largest ever built with a solvent circulation rate of 30,000 barrels daily. The plant was designed and built by The Lummus Company with the exception of the Duo Sol unit which was provided by Max B. Miller Co. Cit-Con has been operating steadily at capacity and Cities Service Company has established barge transportation to deliver products by the water route to its compounding plant near Chicago.

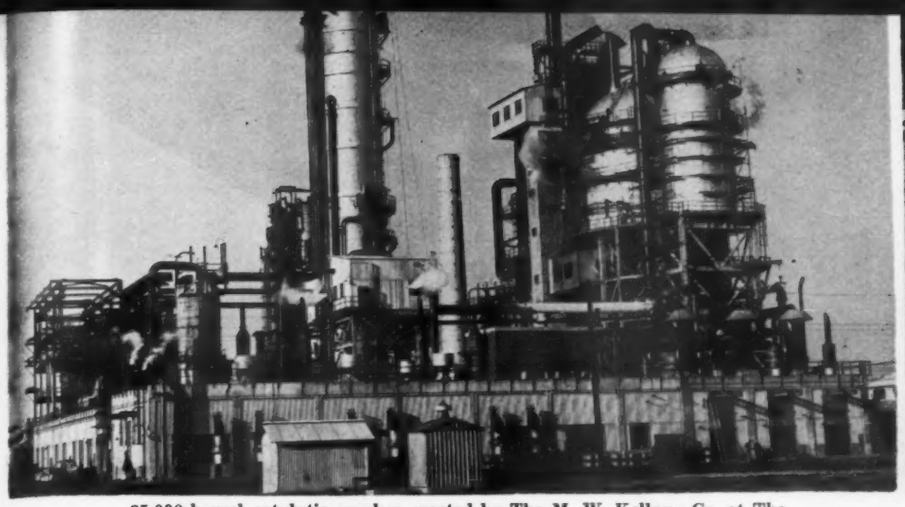
A notable event of the past year was completion by The Lummus Co. for Cities Service and Continental Oil Companies of the 6,000-barrel Cit-Con lube plant at Lake Charles, La. Fritze Henle photo for Cities Service Oil Co.

All piping at the Paulsboro, N. J., refinery of Socony-Vacuum Oil Co. is above ground on a 2,000-foot elevated pipeway.



As part of its $22,500,000 expansion program at Toledo, Ohio, Sun Oil Co. completed in April a 308-foot quadruple reactor Houdry catalytic cracking unit.





25,000-barrel catalytic cracker erected by The M. W. Kellogg Co. at The Texas Co. Eagle Point, N. J., refinery.

Scale model of Union Oil Company's $5 million research center being built at Brea, Calif. Twelve main units will occupy a 100-acre site.

Three new TCC units are being added to the Beaumont, Texas, refinery of Magnolia Petroleum Company and are expected to provide a 50 percent increase over the 10,000-barrel-per-day capacity of the units they replace. The replacement is expected to be completed by the end of the present year, under supervision of The Lummus Company.

In continuation of the expansion program at its Smith's Bluff Refinery at Nederland, Texas, Pure Oil Company early in 1950 opened a lubricants plant which had been under construction since 1948. Principal elements include a crude atmospheric and distillation unit supplied by Foster Wheeler Corporation, a deasphalting and phenol extraction unit by The M. W. Kellogg Co. and an MEK dewaxing, contact filtration and wax recrystallization section designed by The Lummus Company. A grease compounding and blending and high pressure steam generating plant together with a steel and concrete wharf was constructed by Stone and Webster Engineering Company. The lubrication plant components provide for a production of finished oil blending stocks of 90,000 gallons per day of finished neutrals, bright stocks and specialties at several levels of viscosity and V. I.

In the Rocky Mountain district two refineries were completed late in 1949 at Billings, Montana. One of these was a 30,000 barrel plant built by Carter Oil Company and the other of 7,500 barrels capacity by Continental Oil Company which includes a desulfurizing unit. At Casper, Wyoming, Socony Vacuum Oil Company completed the modernization of its refinery during 1949 including installation of a TCC cracking unit.

At Salt Lake City, the Salt Lake Refining Company, subsidiary of Standard of California, will complete a $10,000,000 expansion program before the end of this year. Now under construction, as additions to the plant built in 1948, are a Houdriflow catalytic cracker, additional storage facilities, loading racks, and such auxiliaries as a cooling tower, boiler plant, and booster pump station.

This refinery was built to handle crude output of Rocky Mountain oil fields in the immediate post-war era as Standard began a program of expansion in the Intermountain region. When first completed, it was built around a basic crude distillation unit consisting of an atmospheric pressure column and a vacuum tower. Following completion of the cat cracker, the existing units will turn out feed stocks for the Houdriflow unit, with the result that there will be a greater production of high octane gasolines and diesel fuels and loss of heavy fuel oil. Capacity of the plant also will be increased. The cat cracker will be able to process feed stocks produced from 24,000 barrels of crude oil daily, where only 15,000 barrels of crude are now being handled.

Union Oil Company of California has about completed a $12 million expansion program at its Oleum, California, refinery which roughly triples its capacity to produce its Triton motor oil besides making it possible to manufacture a more diversified line of waxes with greater flexibility of operation. Additions to the plant include a crude distillation unit, gasoline redistillation, duo-solvent treating, dewaxing and filtrol fractionating units. In addition Union is spending five million dollars on a new research center at Brea, California, which will be completed in 1951.

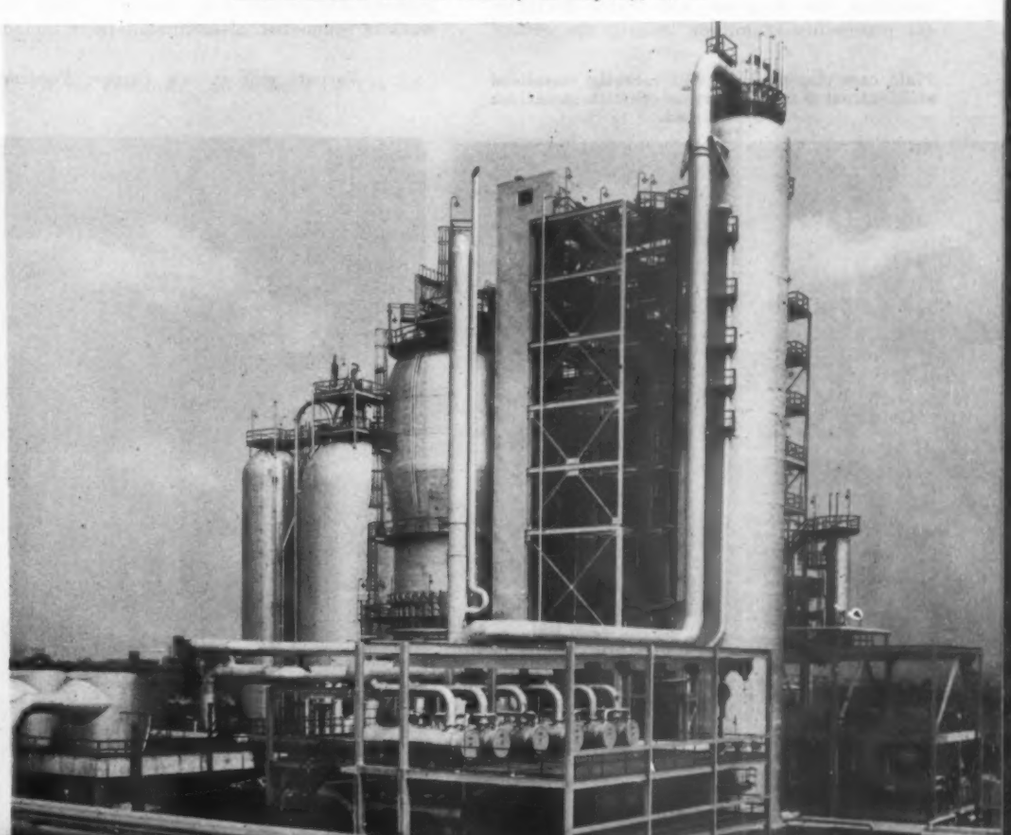
A $600,000 improvement project has been completed at the General Petroleum Torrance refinery which almost completely eliminates the burning of hydrogen sulfide in the refinery's gas fuel. The installations comprising the project were put into operation in March 1950.

The installation includes: a gas collection system which brings to a central point in the refinery all gases which will later be burned as fuel, including some liquefied petroleum gases; an absorption plant where these gases are contacted with a solution of diethanol-amine which absorbs the hydrogen sulfide from the gases; a double pipeline, 8.5 miles in length, through which the solution containing the absorbed hydrogen sulfide is pumped to the Hancock Chemical plant. At this plant the hydrogen sulfide is extracted from the solution. The pure solution is then pumped back through the other part of the pipeline to the refinery where it is reused.

Other improvement projects are now in the design stage and will bring General Petroleum's expenditures on smoke, fume and odor control to over $1.2 million.

(Please turn to page 106)

Largest fluid cat cracker in the world is the 41,000-barrel unit completed during the past year at the Esso Standard Oil Co. refinery at Bayway, N. J.



Refinery Facilities Expand Through-

THE new pattern of the world's refining industry is now taking definite form. It provides for a great increase in processing facilities to meet the rising demand for petroleum products in all parts of the globe and for the more even distribution of these facilities, with the tendency to locate plants more closely in relation to the markets they are intended to serve, rather than contiguous to the sources of crude supply.

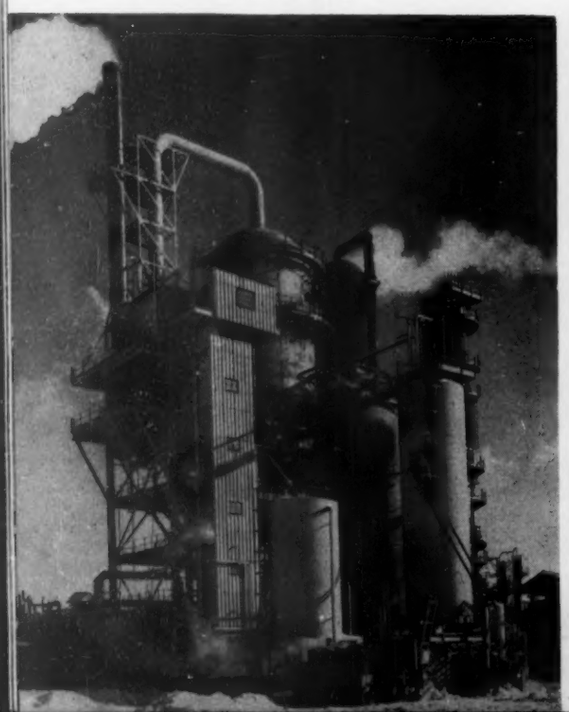
In western Europe the program for a greatly expanded refining industry was part of the original Marshall Plan for economic recovery. It was dictated in a measure by the desire to reduce the currency obligations of the various countries in settlement of their trade balances. It has been stimulated to a degree by financial assistance from the Economic Cooperation Administration, though by far the greater part of the investment required has been provided by private capital.

Completion of refining projects already under way will enable the larger countries of western Europe to supply the requirements of their own markets and in some cases to provide a surplus for export. In the United Kingdom the program will create facilities for processing 18 million tons by the end of 1952 with provision for additions to take care of whatever growth in consumption may take place. French refineries at present are capable of satisfying current demands with additional capacity scheduled to become available in the course of the next two years. In Italy the construction that has been authorized, most of which is now in progress, will put that country in position to become a substantial exporter. The progress of activity in these areas is discussed in more complete detail in articles appearing in other pages of this issue.

A number of other countries, which have been content in the past to rely in whole or in part upon importation of petroleum products, are moving to establish refining industries of their own. An example is the Netherlands where the new Caltex refinery opened early in the present year will add a million tons annually to the volume of oil processed. At the same time the Royal Dutch-Shell Group, which operated a refinery of about 10,000 barrels daily capacity at Pernis before the war, is rebuilding its plant on a greatly enlarged scale which will enable it to process 3.5 million tons annually when the work is completed. New installations include a distillation unit of 45,000 barrels daily capacity, a catalytic cracking unit handling 22,500 barrels per day, together with reforming and other units to round out processing operations.

Adjoining the refinery is a petrochemical plant which went into operation late in 1949 to produce synthetic detergents and plastics, utilizing waxes and gases supplied by the refinery. Altogether the Royal Dutch-Shell Group, through its subsidiary, Bataafsche Petroleum Mij., is expending some $45 million on the expansion of its manufacturing facilities in the Netherlands.

Projected additions to refining facilities in Belgium will add 35,000 barrels or more to daily throughput. Construction is now proceeding on the plant of Soc. Industrielle Belge de Petroles, jointly owned by Anglo-Iranian Oil Co. Ltd. and Petrofina. It occupies a site of 370 acres in the Port of Antwerp and when completed late in 1951 will have a daily crude capacity of 26,000 barrels and will include distillation, thermal cracking and reforming units. In Antwerp also Raffinerie Belge de Petroles S.A. has added a crude distillation unit of 2,000 barrels daily, cracking, reforming and gas recovery units.



Fluid catalytic cracking unit recently completed at Montreal East refinery of British American Oil Co. Ltd.

Vacuum unit at new Cardon, Venezuela, refinery of Shell Caribbean Petroleum Co.

out the World

Refinery under construction by Sinclair Oil and Refining Co. at Puerto La Cruz, Venezuela. Elwood Payne photo.

Esso Standard Refining S.A. is building a plant of 25,000 BD capacity in Antwerp, completion of which is expected in 1953.

While western Germany has increased its refining capacity fourfold during the past four years by rehabilitation and enlargement of war-damaged plants, there is still room for expansion to keep pace with the industrial recovery of the area. Restoration of the Hamburg-Harburg plant of the Royal Dutch-Shell Group, which was the largest of the country's refineries before the war, made such progress during the latter part of last year that it reached a daily treating capacity of 9,000 barrels. Further progress toward rehabilitation of its facilities is underway. Installation of three distillation units at the Ebano Asphalt Werke of Esso Standard in Hamburg raised its throughput capacity to 12,500 barrels daily, and further additions are being made. Installation of a 9,500-barrel topping unit of Deutsche Vacuum Oil A.G. at Bremen-Oslebhausen and improvements in its smaller establishment at Wedel-on-Elbe have added to the capacity of the company.

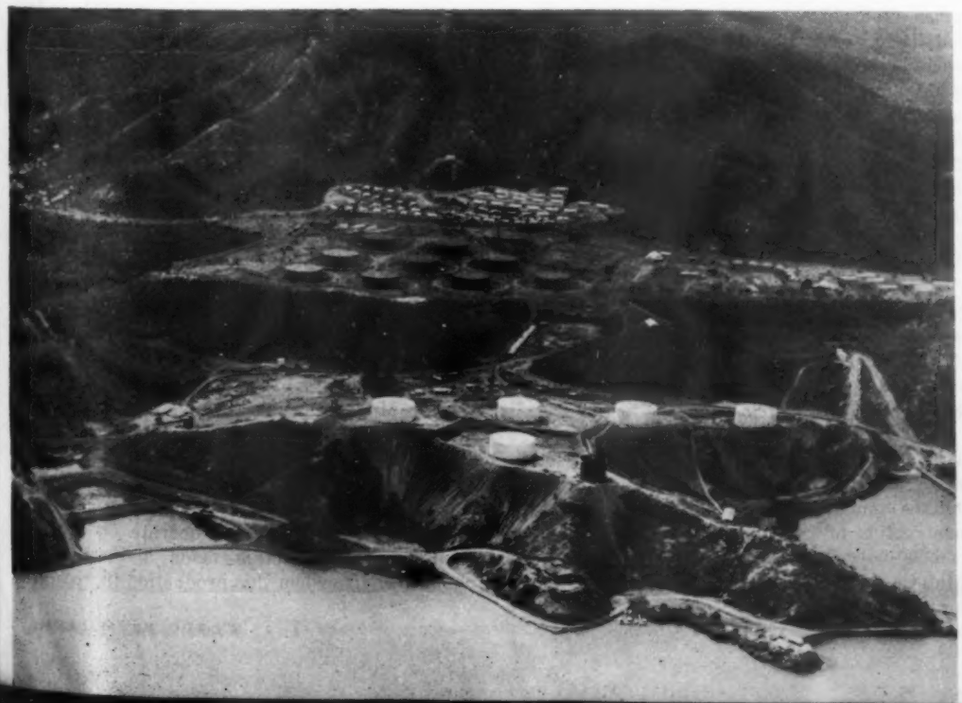
Reconstruction of the "Eurotank" refinery at Hamburg, which was nearly demolished during the war, is progressing steadily. The plant was acquired from its former owner in December 1948 by Anglo-Iranian. Restoration was begun early in the following year, and the plant now has an operating capacity of about 5,000 barrels daily, which will be raised to 12,000 barrels when present work is completed next year. Several of the smaller German-owned plants have been able to add to previous capacity during the past year, while other applications are awaiting approval. Refinery throughput has increased from 30,000 barrels daily in April 1949 to approximately 75,000 at present.

Spain's ambition to have a modern refinery is being realized through construction of Rafineria de Petroleo de Escombreras, S.A., near Cartagena. This company is owned 52 percent by the National Institute of Industry, 24 percent by the Spanish Petroleum Company S.A., and 24 percent by Caltex Oil Products Company. Present capacity of the plant, 5,000 barrels daily, will be raised to 20,000 barrels when construction is completed. The plant will be equipped with units for crude distillation, thermal reforming and polymerization for the production of high-grade gasoline, kerosene, fuel oil, lubricants, paraffin wax and asphalt.

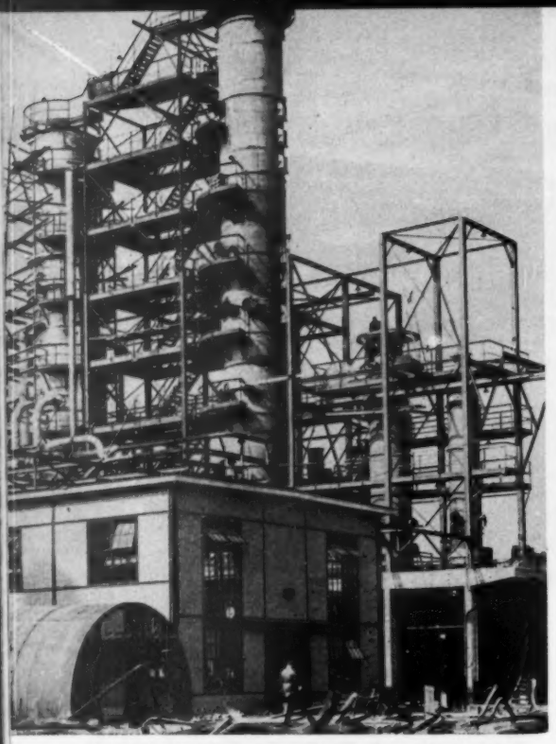
Compania Espanola de Petroleos is enlarging its plant at Santa Cruz de Teneriffe, Canary Islands, by addition of a 5,000 barrel atmospheric and vacuum distillation unit which will raise its daily capacity to 14,000 barrels. A UOP fractionator is being added this season. The refinery is also installing a lube oil unit of 400 barrels daily capacity, incorporating propane deasphalting, furfural treating, benzol solvent dewaxing and clay percolation equipment for the production of motor and aviation lubricants. To handle the increased output, the loading lines and other transport facilities are being expanded.

Various proposals for refinery construction have been put forward in other parts of Europe, in Denmark, Greece, Yugoslavia and Turkey, but these thus far are in the dis-

Puerto La Cruz, Venezuela, refinery built by The Lummus Co. for Venezuela Gulf Refining Co. Elwood Payne photo.



Sixty-ton tower being loaded at Brooklyn, N. Y., for shipment to Socony-Vacuum's new lube plant at Gravenchon, France.



Crude distillation unit being erected at Pernis, Holland, for Caltex. Fractionating column in center was fabricated in England by G. A. Harvey & Co.

cussion or planning stage. From behind the Iron Curtain little information as to refining operations is available. From fragmentary reports, it is evident that Romania's production continues to decline and that no substantial improvement has been made in its outworn refining equipment. Little change is ascertainable in the other Soviet satellites, Hungary, Czechoslovakia and Poland. The Soviet Union itself makes no specific reports on its petroleum operations, but it is assumed that some additions to its capacity have been made.

In the Middle East the proposals for new refineries on the shore of the eastern Mediterranean or the Persian Gulf appear to be in abeyance, presumably because of the stepped-up activity in European construction, but the plants previously established there continue to add to their facilities. The Abadan refinery of Anglo-Iranian, which already has attained a daily capacity of 500,000 barrels, is installing a 30,000-barrel catalytic cracker designed by Foster Wheeler Corp., which will be ready for operation in 1951. It is also adding a 400-barrel lube oil unit to supply lubricants to the local market, a gas plant and gas recovery unit, the three latter being constructed by the Badger Company. Work is proceeding also on a new power station.

At the plant of Bahrein Petroleum Company in the Persian Gulf a 55,000-barrel crude distillation unit, engineered by The Lummus Company and erected by International Bechtel, is nearing completion. It replaces equipment previously in use. The power plant installation has been enlarged, and other accessory facilities are being expanded. Arabian American Oil Company is installing in its Saudi Arabian plant a stabilizing unit of large capacity, engineered by the Fluor Corp., Ltd., and is constructing an asphalt plant to serve local needs.

Several attempts have been made to arrange for reopening of the Haifa plant of Consolidated Refineries Ltd., jointly owned by Anglo-Iranian and Shell, which has been out of operation except for a short interval since early in 1948 because of the refusal of the Iraqui government to permit the delivery of Iraq crude through the pipeline serving the refinery. Recently the government of Israel renewed discussion of this proposal, and it is announced that the plant will operate at part capacity on outside crude to supply the local needs of Israel.

In Indonesia the large refineries of Standard Vacuum and Shell in South Sumatra have continued in full operation, and in Borneo work on the enlargement of Bataafsche Petroleum's Balikpapan plant has been going forward. Elsewhere in the Orient disturbed conditions have militated against new activities except in Japan, where refineries have been permitted to resume operations, and improvements in certain plants under arrangements between Japanese and foreign companies are in contemplation. The governments of India and Pakistan have indicated their interest in the establishment of new refineries, but these suggestions have not yet led to definite projects.

In Australia the past year has witnessed the completion of bitumen plants by Shell and Vacuum Oil Pty., and Shell Co. of Australia has gone forward with the construction of a refinery and a lube oil plant to go into operation late 1950 or 1951

In the western hemisphere a notable expansion of refining facilities has taken place in Canada. The increase has occurred both in the east, where it has been due to the rising demand for petroleum products, and in the western provinces, where discoveries of a succession of prolific fields has added greatly to potential production.

At Montreal, chief refining center of eastern Canada, three large plants equipped with the most modern appliances for efficient manufacture of petroleum products have come into operation. Modernization of the plant of Imperial Oil Ltd., at a cost of $22 million, raising its crude charging capacity to 37,000 barrels daily, was virtually completed last year. This was followed by the opening of the British American Oil Co. Ltd. at Montreal, where the daily charging capacity was raised from 15,000 to 32,000 barrels by the installation of a 13,000-barrel fluid catalytic cracking unit, a polymerization plant for the production of high octane gasoline and new facilities for other products. Third of the expansionist programs at Montreal is that of Shell Oil Co. of Canada Ltd., which raised the capacity of its plant from 10,000 to 27,000 barrels daily by installation of catalytic cracking and vacuum flashing units constructed by Arthur G. McKee & Co., together with gas recovery and treating units by Fluor Corporation. McColl-Frontenac Oil Co. Ltd. has been carrying out a program of expansion at its Montreal plant which is now practically completed and raises its daily capacity from 18,000 to 40,000 barrels.

Expanding potential of the oil-producing areas in the Prairie Provinces of Canada has led to the enlargement of existing refineries and the announcement of plans for the early construction of new plants. Among these is a 6,000-barrel refinery equipped for fluid catalytic cracking to be built by British American Oil Co. Ltd. at Edmonton, Alberta, construction of which is expected to be completed in 1951. McColl-Frontenac Oil Co. Ltd. is also constructing a fluid catalytic cracking plant at Edmonton to be finished next year, and Imperial Oil Ltd. is building a plant of 10,000 barrels' daily capacity near Winnipeg, Manitoba. Enlargements in capacity are planned by a number of other refineries.

Petroleos Mexicanos, official oil administrator of Mexico, is proceeding with construction of the plant at Salamanca which is being constructed by Arthur G. McKee & Co. and is to have a daily crude capacity of 25,000 barrels. According to schedule this plant is to be completed during the current year. Another refinery, a 5,000-barrel plant, has been authorized for erection at Reynosa and is expected to be finished in 1951. Location of other plants is likely to depend upon results of the drilling program which the company plans to undertake.

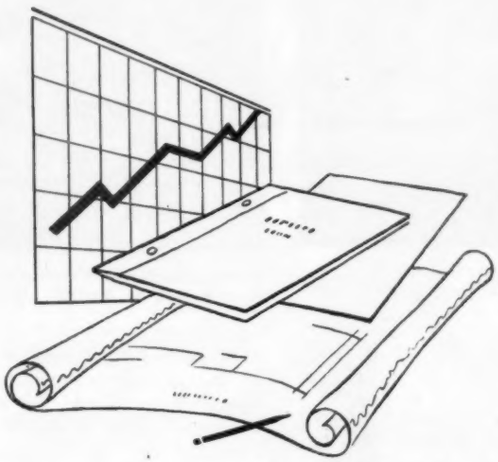
The largest refining industry of South America is that of Venezuela. The two great new plants of Shell Caribbean at Punta Cardon, which went on stream early last year, and that of Creole Petroleum Corporation, which had its official opening early in 1950 with a combined capacity of 120,000 barrels daily were sufficient to put it well in the lead of any of its neighbors, but several important additions to these facilities will be made during the current year and in 1951.

Sinclair Oil and Refining Co. is building a plant of 35,000 barrels daily capacity at Puerto la Cruz, which will be completely equipped for the production of gasoline, distillates and fuel oil. It is expected to be ready for operation by the end of 1950. At the same point the plant of Venezuela Gulf Refining Co. is now approaching completion. The company is owned by Gulf Oil Corporation and Texas Petroleum Company, the latter having a 35 percent interest. The refinery is constructed under the engineering direction of The Lummus Company and will have a daily capacity of 30,000 barrels, producing gasoline, kerosene, fuel oil and naphtha.

Phillips Petroleum Company through its subsidiary, Phillips Oil Company, has prepared plans for a refinery and wax plant in the San Roque field in eastern Venezuela, which will produce two million pounds of wax per year and is to be completed in 1952. Richmond Exploration Company, subsidiary of Standard Oil Company of California, was reported to be preparing the erection of a refinery at Rio Grande, Venezuela, but latest reports are that this has been deferred for the present. Other companies operating in Venezuela will be obligated under the terms of their concessions to establish refineries whenever their production reaches a certain point. The plants already in operation or under construction, however, will give the country a refining capacity of well over 200,000 barrels daily.

Brazil's efforts to build up a refining industry of substantial dimensions are being continued. The small plant at Mataripe in Bahia is being constructed under the engineering direction of The M. W. Kellogg Company with an initial capacity of 2,500 barrels per day. It is to operate on crude produced in the Bahia fields and will be doubled in size when this production increases

REPORTS AND APPRAISALS



Stone & Webster Engineering Corporation has had broad experience in the preparation of many comprehensive economic studies, some industry-wide in scope, for clients in the petroleum and related fields.

These studies have embraced investigations of specific engineering problems — examination of existing enterprises including organization, financial structure, sales policy, manufacturing methods — recommendations for prospective enterprises including products, plant location and estimates of capital cost and production expense.

If you are contemplating expansion or reorganization of a present enterprise or organization of a prospective enterprise, this experience may help you realize substantial economies.

STONE & WEBSTER ENGINEERING CORPORATION

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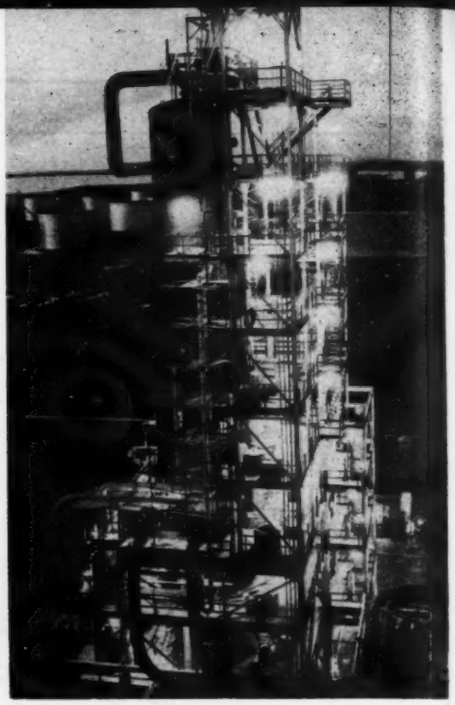
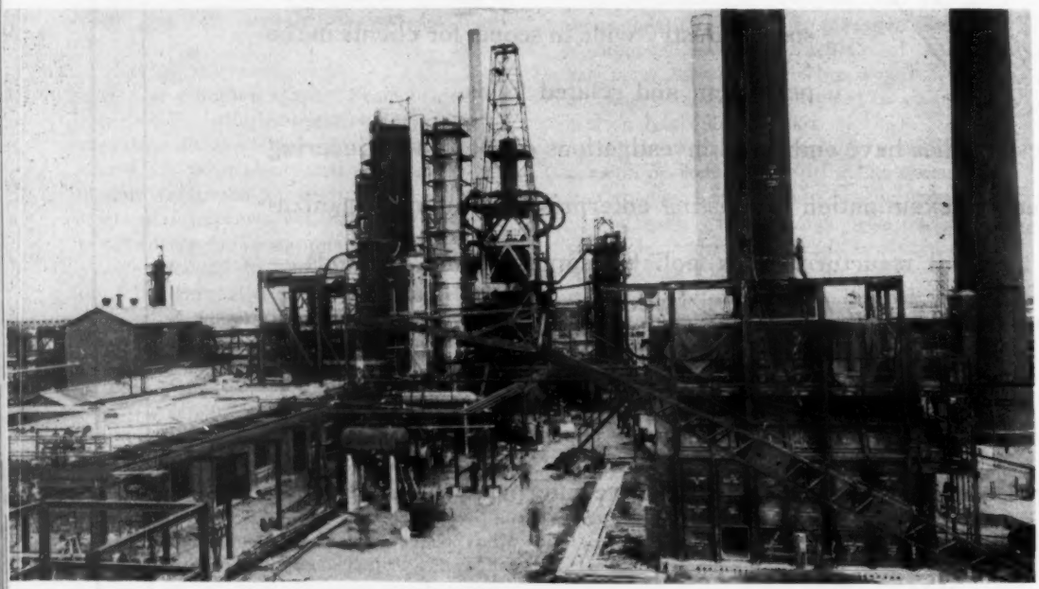
Punto Adaro, one wing of the Creole Petroleum Corp. refinery project at Amuay Bay. Family housing is in the background, temporary personnel housing in middle, and village of Punto Fijo in foreground.

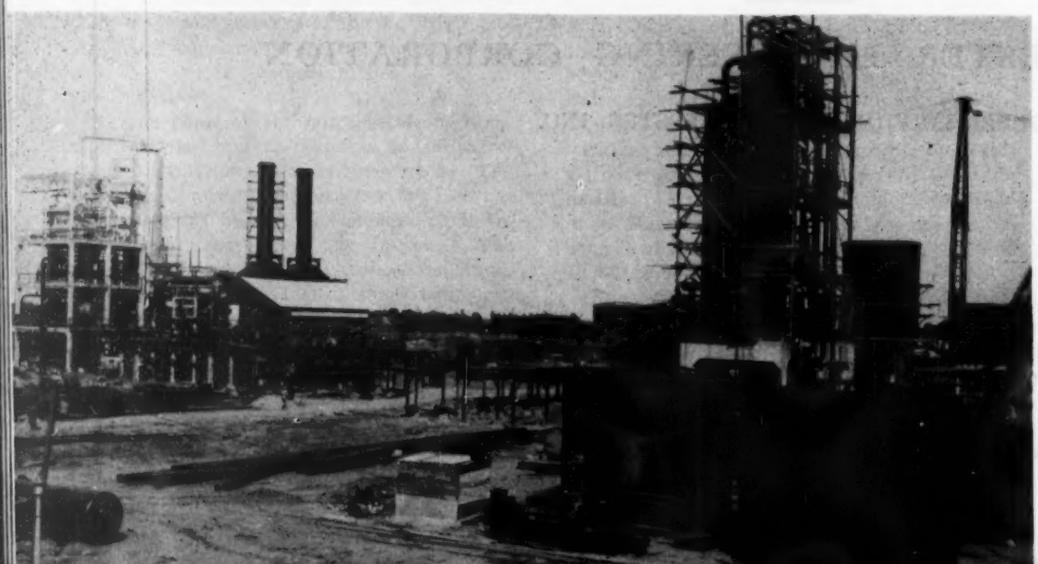


Amuay refinery of Creole Petroleum Corp. is one of two largest postwar projects in Venezuela.



Shell Oil Co. of Canada, Ltd., is increasing the capacity of its Montreal refinery from 10,000 to 27,000 barrels daily and installing catalytic cracking facilities.

View during construction of 25,000-barrel refinery for YPF at Puerto La Plata, Argentina. Topping unit is at left.



sufficiently. Contract for the larger plant of 45,000 barrels' capacity to be built at Belem, Para, under the technical direction of Hydrocarbon Research, has been let to French firms. Other plants that have been authorized but not yet built are those of Refinaria e Exploraco de Petroleo Uniao at Sao Paulo, of 20,000 barrels, and Refinaria de Petroleos do Distrito Federal, of 10,000 barrels, at Rio de Janeiro.

Argentina is a country which still has to import more than half of all the oil it consumes and is anxious to increase both its domestic production and its refining capacity. Several additions have been made in recent years to its plant at Puerto la Plata, largest in the country. Latest of these was a crude distillation unit of 25,000 barrels' daily capacity which went into operation in March last. It was designed by Catalytic Construction Company of Philadelphia. A similar plant with topping and treating units will be completed by the end of the present year, and the two together will more than double the daily crude capacity of the refinery. A new refinery being built for Yacimientos Petroliferos Fiscales in Buenos Aires by The M. W. Kellogg Company with a daily capacity of 28,000 barrels is to be completed in 1951.

Two plants have been built by Foster Wheeler Company for Yacimientos Petroliferos Fiscales of Bolivia. One of these, a topping plant of 2,000 barrels' capacity at Sucre, has been completed, and the other, a combination topping and reforming plant of 5,000 barrels' capacity at Cochabamba, is to be ready for operation by the end of the year.

As a result of the growth in the world refining industry, the daily capacity of plants outside the United States has risen to approximately 5,000,000 barrels, an increase of 45 percent since the end of 1946. It now represents approximately 42 percent of the total world capacity as compared with 6,750,000 barrels or about 58 percent within the United States. In cracking capacity the balance is still strongly on the side of the United States with 74 percent of the total.

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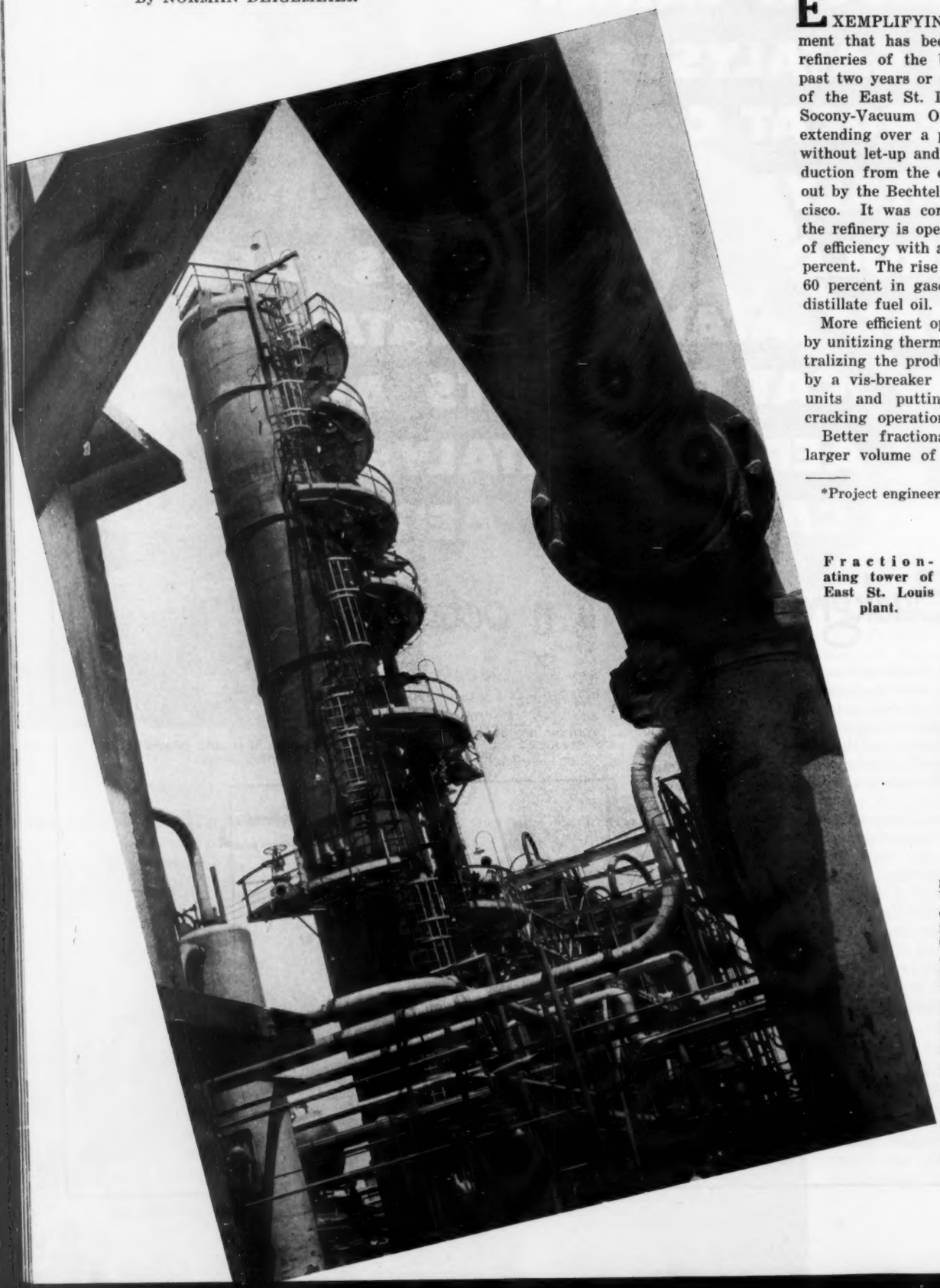
Modernization Increases Capacity and Efficiency of East St. Louis Refinery

By NORMAN DEIGLMEIER*



Fractionating tower of East St. Louis plant.

EXEMPLIFYING the modernization movement that has been under way among the refineries of the United States during the past two years or more is the reconstruction of the East St. Louis, Illinois, refinery of Socony-Vacuum Oil Company. This task, extending over a period of eighteen months without let-up and without interrupting production from the existing plant, was carried out by the Bechtel Corporation of San Francisco. It was completed in April last, and the refinery is operating on a new high level of efficiency with an increased capacity of 50 percent. The rise in output shows a gain of 60 percent in gasoline and of 25 percent in distillate fuel oil.

More efficient operation has been obtained by unitizing thermal cracking operations, centralizing the production formerly turned out by a vis-breaker unit and two vapor phase units and putting control of all thermal cracking operations into one control house.

Better fractionation and production of a larger volume of high quality gasoline has

*Project engineer, Bechtel Corporation.

Norman Deiglmeier

Graduating in chemical engineering from University of Washington, Mr. Deiglmeier entered the refinery engineering field with the Standard Oil Company of California concerned with the design of processing units for the Bahrein, El Segundo and Richmond refineries. In 1940 he joined the Bechtel organization. Since then, with the exception of a period in military service, he has been concerned with engineering design of large chemical plants and refineries throughout the world. At present he is working with the San Francisco engineering division as a project engineer.

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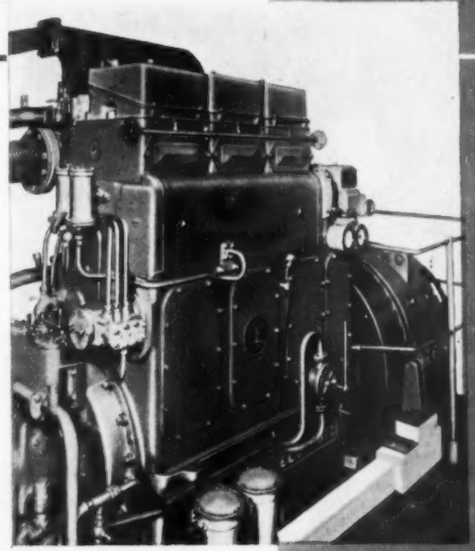

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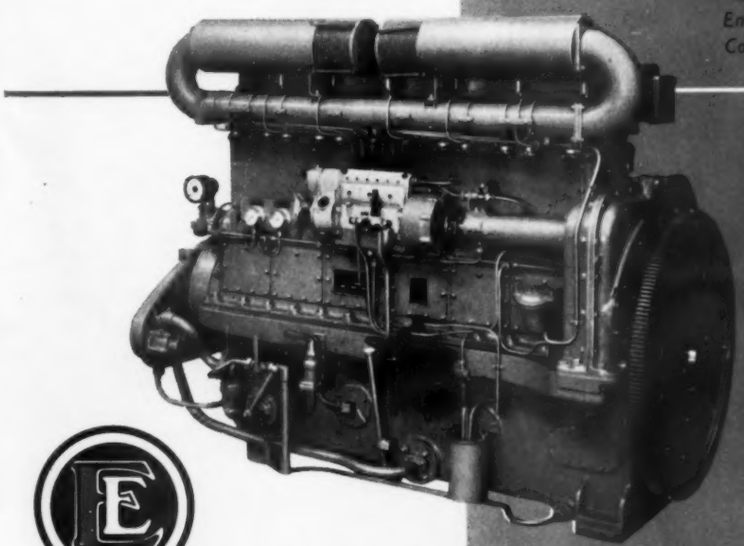

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followed the installation of new units and the modernization of those already in place, together with the new tannin solutizer.

Designed capacity provides a substantial margin over current production to allow for future market expansion. The enlarged capacity for production of high octane gasoline is of significant value in national defense planning.

In line with Socony-Vacuum's energetic policy of developing the maximum safety in working conditions in all its installations, Bechtel engineers in their design paid particular attention to such safety features as alternate access and escape routes, head clearances, accessibility of valves, controls and equipment, fire protection facilities and the like.

Production first began at the East St. Louis refinery in 1918 under the ownership of the Lubrite Refining Company. The plant was originally built to manufacture lubricating oils by the Wells process. Crude was received in tank cars. By the end of its first year three separate stills were in operation, capable of processing 700 barrels daily. It was producing a high grade gun oil, sewing machine oil and lubricating oil comparable to today's SAE60 grade oil. In 1923 operations were changed from manufacture of lubricating oils to the manufacture of gasoline, kerosene, gas oils and heavy fuel oils. The Vacuum Oil Company acquired ownership of the refinery in 1930 and continued the expansion of manufacturing and marketing operation. Pratt vapor phase units were completed in 1931, along with a new gas absorption plant and treating plant. Coking ovens were erected in 1935 and a crude topping unit in 1937. Major expansion programs took place in 1939-1940 and again in 1943-1944 with the addition of a boiler plant, Houdry unit, gas plant, TCC unit and alkylation units.

To meet the record-breaking postwar demand for petroleum products, Socony-Vacuum set forth on an extensive modernization and expansion program in 1948, and Bechtel construction crews moved onto the jobsite in September of that year. Installation of three main units was involved, partially replacing equipment previously in use. The new features consisted of a single-stage crude distillation unit, a combination thermal cracking unit and coking unit, and a tannin solutizer unit for the treatment of gasoline.

Charging capacity of the new crude unit is 15,000 barrels daily of midcontinent crude, raising the refinery crude oil throughput to 30,000 barrels. Distillates produced are straight-run gasoline, a light naphtha for reforming, kerosene and topped crude bottoms for charging the catalytic cracking units.

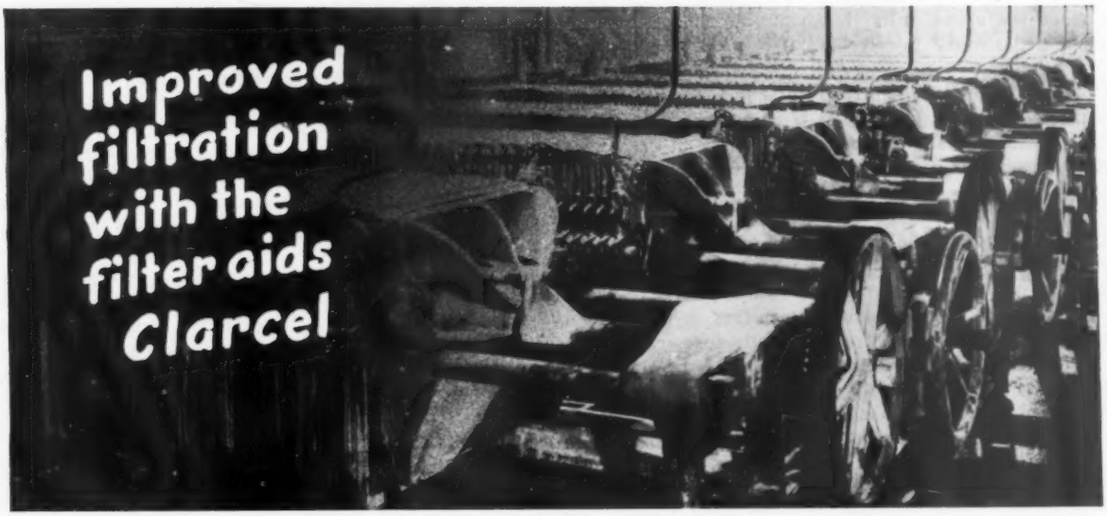
The thermal unit is a combination cracking plant for the selective cracking of naphtha, catalytic gas oil and the viscosity reduction, or alternately coking, of heavy residuum. Three furnaces are used, one for each charge stream. Two main fractionators, a vis-breaker coker column, a gas oil column and a complete gas plant including compressors, absorber and stabilizer were installed. The combined charging capacity is 13,000 barrels daily. The unit produces a stabilized butane-propane fraction, debutanized gasoline, vis-breaker or coker gas oil, heavy fuel oil and coke.

The coking portion of the thermal unit utilizes the delayed cracking process wherein cracking is carried as far as possible so that the fuel oil feed is cracked to gasoline and gas oil leaving a residue of coke. Flow of the input fuel oil proceeds through the vis-breaker-coker, furnace, then into the bottom of one of the two coke drums. There the oil soaks at a temperature above cracking. Vapors formed by the cracking process are taken off at the top of the drum and are fractionated in the vis-breaker-coker column, recovering gas, gasoline, gas oil and fuel oil. The coke gradually increases as a residue in the drum. At the end of a 24-hour run over 200 tons accumulate. Then the charge stream is switched to the empty drum and the coke in the full drum is cooled with steam, then water, and is cut out by the hydraulic method. Jets of water at a pressure of 1,500 psi are applied by drills to cut the coke into pieces small enough to drop out of the drum directly into railroad gondola cars for shipment to market.

A Dorr thickener is used to remove coke fines from the water that has drained off from

Thermofor catalytic cracking unit at East St. Louis refinery.

Solutizer unit for sulfur removal.



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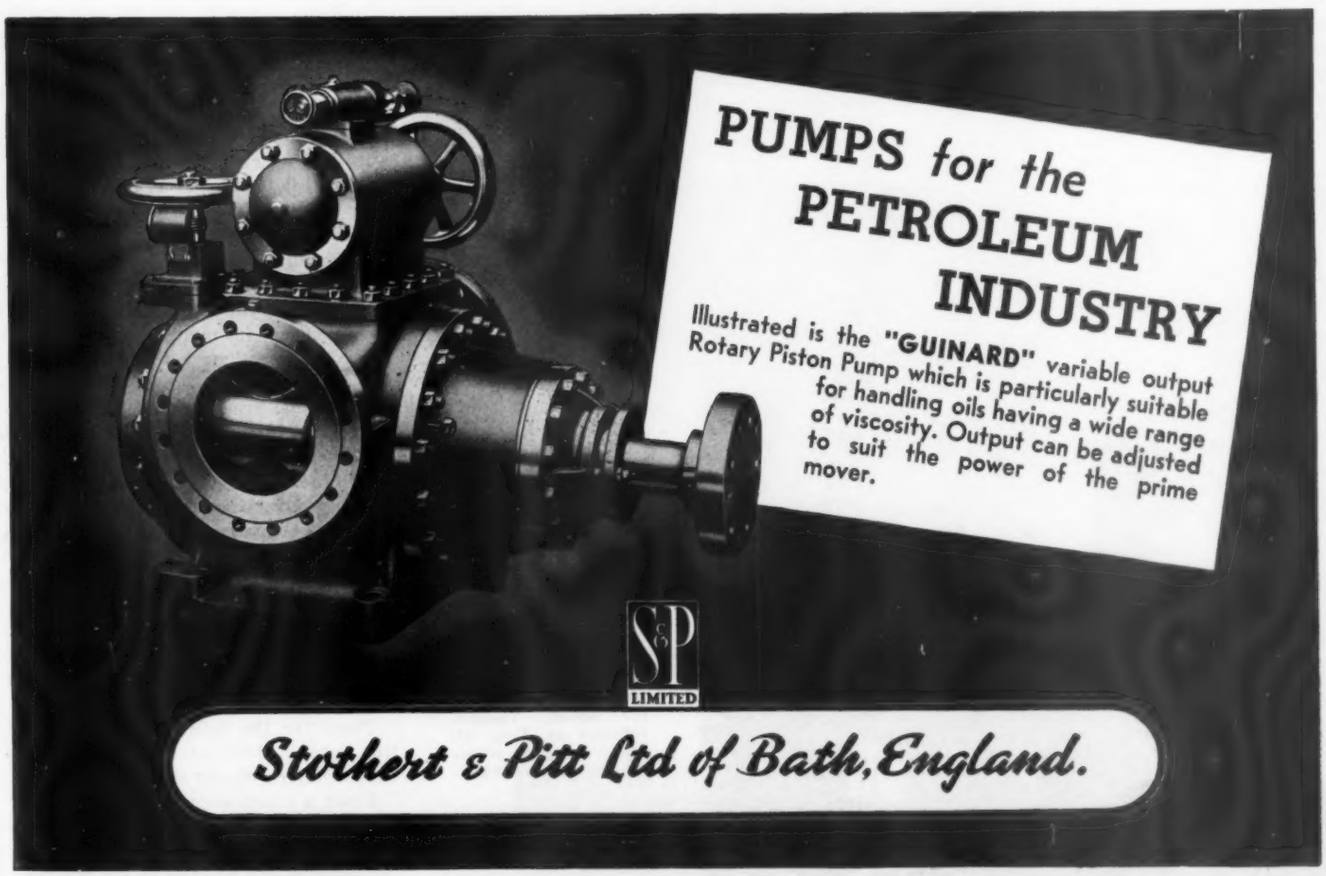
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the cars. The high-grade coke produced is suitable for such industrial usage as the manufacture of electrodes extensively used in the extraction of aluminum from bauxite.

With the addition of the above units the refinery has obtained a flexibility in operation permitting the production of either petroleum coke or fuel oil as may be required to meet current market conditions.

The new gasoline treating plant utilizes the tannin solutizer process for the chemical removal of sulfur compounds. The sour gasoline is first treated with a caustic solution to remove acidic components and to reduce the concentration of cresol. The pretreated gasoline is then put through an extraction column counter-current to lean solutizer solution. The solutizer is a caustic solution containing an organic material, potassium cresylate, which increases the solubility of the mercaptans. Foul solutizer solution carrying the mercaptides is taken off the bottom of the tower, while sweet gasoline product is removed from the top. Two treating sections arranged in parallel were installed, each designed to sweeten 10,000 barrels daily of gasoline. A regeneration system for the solutizer is common to both units and handles the combined spent solution. The two gasoline streams being treated are Socony's regular grade Mobilgas and their premium Mobilgas Special.

Because of the increased refinery capacity brought about by the addition of the above four units, many additions and alterations to existing refinery facilities were required to complete the expansion program. Twenty-one separate projects of alterations and additions were made. Five were major undertakings. These were additions to the gas plant covering the installation of an absorption column, a complete debutanizer unit and various piping changes in the existing plant. This work increased the stabilization or gas plant capacity, providing additional flexibility of operation and permitting the shutdown of an existing debutanizer unit that had become unserviceable.

Three of the five boilers in the refinery boiler house were converted to 375 pound steam service from 180. Air cooled walls were replaced with water cooled walls, and a completely automatic combustion control system was installed. With these changes steam capacity of each boiler was stepped up from 40,000 pounds per hour to 55,000. Additional cooling water facilities were provided by the installation of a new 20,000 gpm induced draft cooling tower, four 7,000 gpm cooling water pumps and an underground cooling water piping system with 36-inch mains. The system provides cooling water for existing units formerly serviced by a spray pond, and for each of the new units. Sometime after the project was started it became necessary for the refinery to process a sour crude where previously only sweet crude had been processed. No facilities were available for the desalting and treating of sour crude. Consequently, highest priority was placed on the design and construction of an electrolytic dehydration unit for desalting the sour crude. Without interruption of the construction program on the other new units, engineering and construction of the desalter was completed within five months.

The expansion program required a complete rebuilding of the primary electrical distribution and substation system at the refinery. Existing transformer substations were modified to provide underground distribution feeders, and new transformers and 13,000-volt metal clad switch gear were installed.

Other work done consisted of additions to refinery fuel gas and fuel oil systems, fire protection and blowdown facilities, sewers, sewage oil recovery system, tank farm piping, interconnecting process piping and yard pipe supports to provide service to and tie together with the existing and new units.

Installing new fractionating tower during construction of the Socony - Vacuum refinery at East St. Louis as part of its expansion program.

Because of space limitations a multitude of construction problems developed during the 18 months on the job. Some part of every unit under construction was completely inaccessible to heavy equipment. Work had to be done without interruption of production or presenting hazards in operating areas. Close collaboration between the Socony operating and engineering departments and Bechtel Corporation engineering and construction departments was maintained in order to keep construction progress at a maximum without interfering with refinery production. Tie-ins of new units into existing systems were made with a minimum of interference with production. Construction work increased to a peak in the summer of 1949 when a 1,000-man crew was being used. By the end of March 1950 all major work had been done and the units had been turned over to Socony for initial operation. On the completion of the modernization program, the new units were integrated into the operation of the existing units so that, briefly, the flow through the refinery is as follows:

(1) Sweet crude is charged to the older crude unit and sour crude is charged to the new crude unit after treatment in the desalter. The distillate streams from the crude units are combined so that the straight-run gasoline is stabilized in the gas plant and blended and treated in the tannin solutizer unit. The straight-run naphtha is charged to the reformer section of the thermal unit, and heavy naphtha to the kerosene treating plant.

(2) Topped crude from the crude units is charged, together with vis-breaker or coker gas oil from the thermal unit, to the TCC and Houdry catalytic units which produce gasolines, gas oils and reduced crude. The gasoline is stabilized in the gas plant and treated in the tannin solutizer unit. The gas oils and reduced crude are charged to the thermal unit.

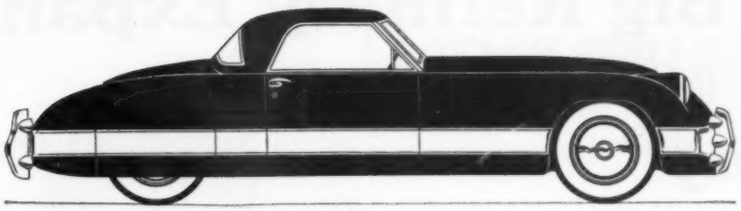
(3) The thermal unit reduces a debutanized gasoline, which is blended and treated in the tannin solutizer, and crude residuum to be marketed as fuel oil or converted to petroleum coke.

Flexibility in the above arrangement is provided so that operation can be adjusted to regularly scheduled maintenance shutdowns or variation in quantities of products required to meet market conditions.

Upon the completion of the project, obsolete thermal cracking and coking units were abandoned and are scheduled to be scrapped. The oldest equipment now in service is the 1937 crude unit. Completion of the modernization program resulted in an overall increase of about 50 percent in the refinery capacity for high-grade motor fuel and other Socony-Vacuum products manufactured in East St. Louis. Gasoline capacity was raised from 462,000 to 756,000 gallons per day. Distillate fuel oil capacity was raised from 200,000 to 250,000 gallons per day, while kerosene capacity also was increased.

Plans for the future include the reactivation late in 1950 of an alkylation unit installed during World War II.

From a plant employing 23 people in 1918 and processing about 1,000 barrels daily of crude oil, the refinery has grown to employ 565 persons and handles an average of 30,000 barrels per day of crude.



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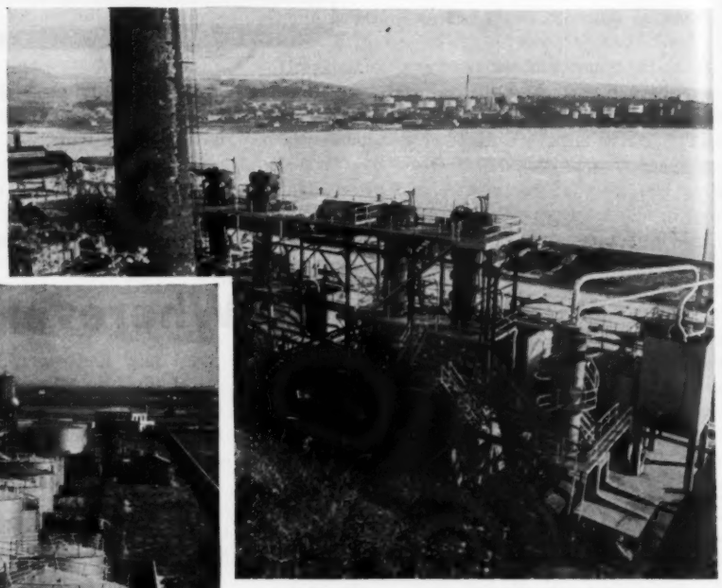
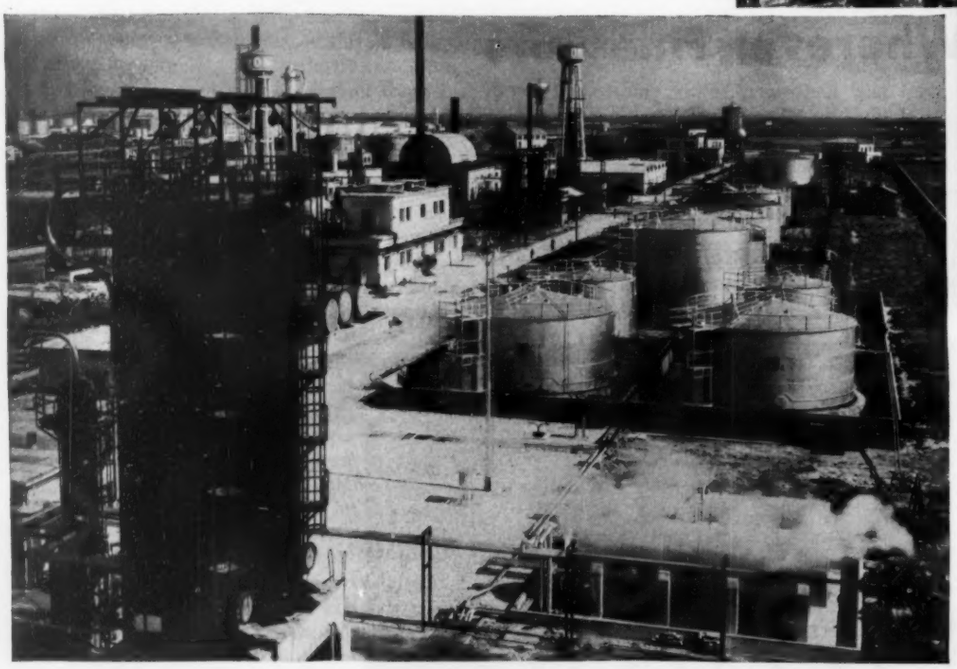
Italy Has Big Refinery Expansion Under Way





Above: Trieste refinery of Standard Oil Co. (N.J.)

Left: IROM refinery at Porto Marghera, near Venice.

WHILE Italy's domestic oil production is as yet inconsequential, less than half of one percent of national requirements, the country's refining industry is of substantial proportions, and is on the way to much greater expansion. Plants that were damaged during the war have been repaired, some have been enlarged and new construction has been authorized or actually begun on a number of others. Apparently the argument of the Italians that their country occupies a strategic position midway between the rich oilfields of the Middle East and the markets of Western Europe for serving the latter has carried weight with the managements of international oil companies. At any rate, many millions of outside private capital are being invested in the expansion of facilities.

In spite of high prices and quota restrictions Italian consumption of petroleum products has risen 27 percent since pre-war, the greatest gain being in fuel oils. The figures for 1949 are as follows:

Product	Metric Tons
Motor gasoline	589,000
Kerosene and gas oil	843,000
Fuel Oil	1,962,000
Total	3,394,000

Present refining capacity is able to meet these requirements with some margin for export and the enlarged facilities now under construction and projected are largely intended to provide products for shipment to areas that can be reached from Italian ports.

At the present time the plant of largest capacity is that of Raffineria di Napoli SAI, subsidiary of Socony Vacuum Oil Company. This refinery which was almost completely destroyed during the war has been fully rebuilt and went on stream in April 1949. It has now reached its planned production of 33,000 barrels daily of which the major part is intended for export. As a result of the company's enlarged operations where formerly 18 tankers visited Naples during a year the number now has risen to more than 200.

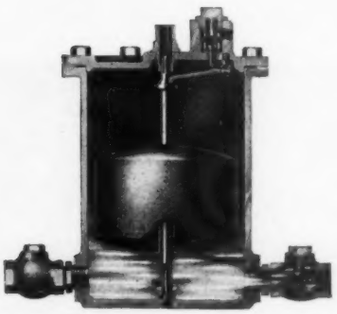
Another large addition to refining capacity is resulting from the purchase by Standard Oil Co. (N. J.) of a half interest in Azienda Nazionali Idrogenazione Combustibile (ANIC) with refineries at Leghorn and Bari. The reconstituted company, now known as STANIC is utilizing its large investment of new funds to rehabilitate both plants and raise their capacity to 26,000 barrels daily. Before the war the ANIC refineries were rated at 6,000 B/D and were supplied with crude from Albania. At present the Leghorn plant which suffered from allied bombing and Nazi looting during the war has been largely restored and that at Bari which was less seriously damaged has been continuously in operation and played an important part in supplying the allied armies during their invasion of Italy. The refineries are now operating on Middle East crude and their products are marketed in Italy through SIAP, the Italian affiliate of Jersey Standard. At Porto Marghera, near Venice, through an arrangement with Anglo-Iranian Oil Company, the plant of Industria Raffinazione Olii Minerali (IROM) is being doubled in capacity at a cost of $6,400,000 by the addition of a combined atmospheric and vacuum unit to handle 12,000 barrels daily, and an acid treating and contact filtration unit for lubricating oils together with an electric generating installation and facilities for truck and tank carloading.

The Royal Dutch-Shell group which has had a refinery at La Spezia, with a capacity raised since the war to 15,000 barrels daily, has been authorized to construct a plant of 40,000 B/D capacity at Apuania, a short distance to the north.

Condor is building a 20,000 barrel refinery at Rho near Milan which will be supplied with crude through a 10-inch pipe line 100 miles in length from Genoa. It will be a combined refining and chemicals plant. Other plants scheduled for completion in 1951 or 1952 are those of Soc. Anon. Raffineria Padana Olii Minerali at Trecate which is planned for 13,000 B/D, Raffineria Olii Minerali Affini of 500 B/D at Milan and that of Italia of 4,000 B/D at Cremona.

Completion of these projects will raise Italy's total plant capacity to approximately 1,200,000 barrels daily.

This patent



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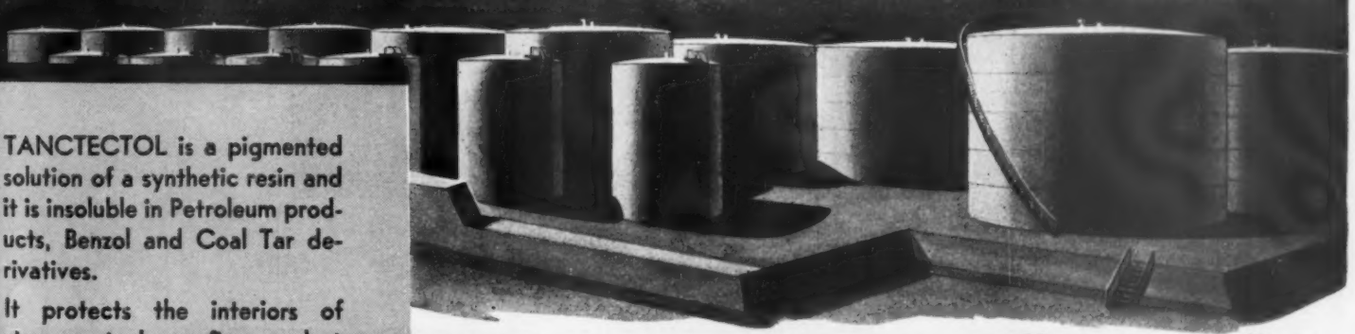

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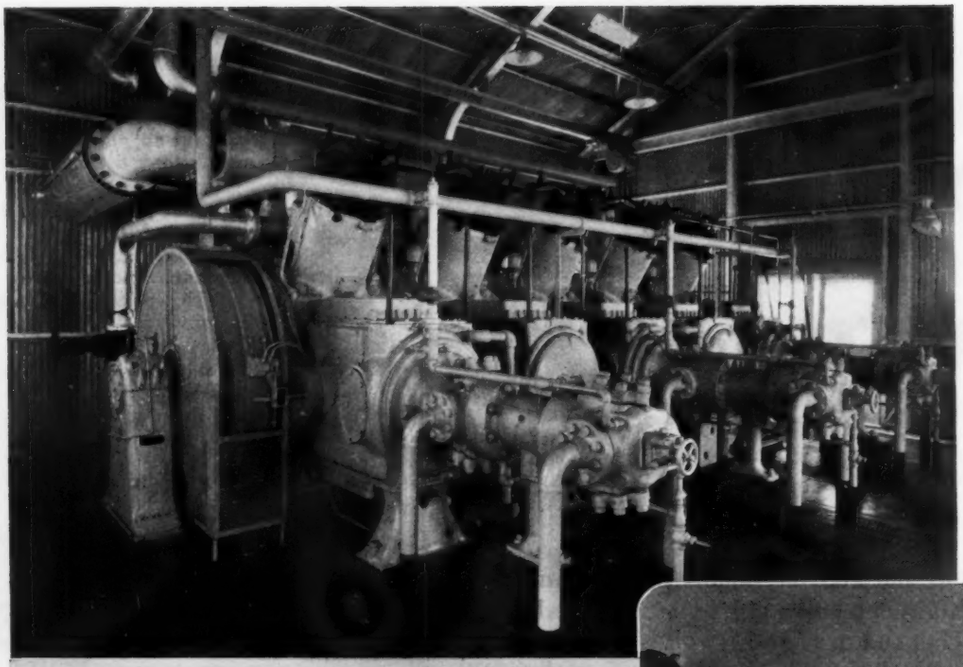
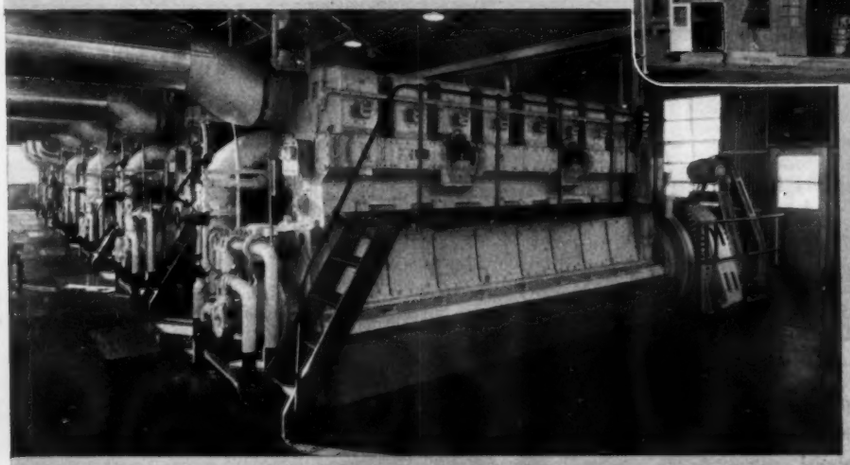


This 10-cylinder, 1100 hp GMV Turboflow compressor, known for extreme compactness and over-all operating economy, compresses residue gas from 1,000 to 2500 psi for return to field reservoir. Automatic control maintains constant pre-set discharge pressure.

Above: exterior of generator building showing muffler, air filter and oil cooler equipment.



This line-up of Cooper-Bessemer gas engines in generating plant consists of four 600 hp, 8-cylinder JS's driving Ideal 400 kw generators and three 280 hp, 5-cylinder Type GS engines driving Ideal 200 kw generators.

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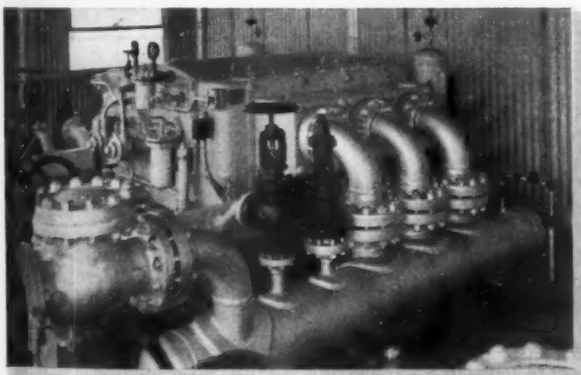
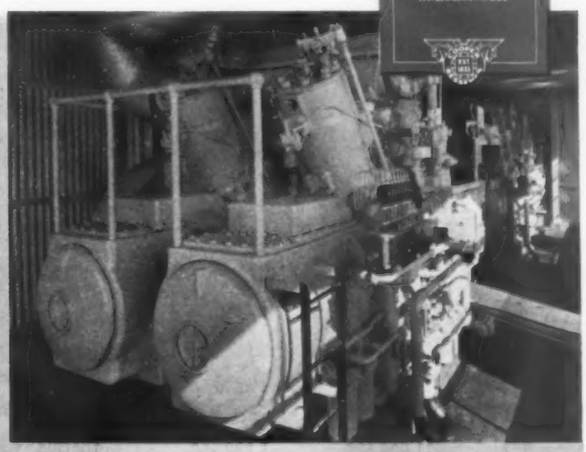
For in this one modern project, as shown here, you'll find Cooper-Bessemer in-line gas engines driving generators for all electric power requirements. And you'll find space-saving Cooper-Bessemer Twin-line pumps handling lean oil. These pumps in turn are direct-driven by compact Cooper-Bessemer GMX V-Type gas engines. Finally, last but not least, a 1,100 hp Cooper-Bessemer GMV Turboflow, tops today in compressor compactness and over-all economy, handles residue gas for return to a field reservoir.

To get at the reason *why* Cooper-Bessemers have been picked for all these services, you have only to weigh the important new developments introduced during recent years by one of America's *oldest* builders of engines and allied machinery.

Another Example of Efficient Power at Lower Cost



One of two Cooper-Bessemer Twin-line lean oil pumps in Sun Oil Starr County plant. High pressure side (foreground) is designed to operate on 41 API gravity lean oil, from 220 to 1100 psi while handling 248 gpm. Other side, in series, operates from 20 to 225 psi while handling 388 gpm.



Two Cooper-Bessemer GMX-4, V-Type gas engines, each direct-driving a Twin-line 6-cylinder lean oil pump through fire wall. Each GMX is rated 200 hp at 400 rpm.

by **Cooper-Bessemer**

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Houston, Dallas, Greggton, Pampa and Odessa, Texas Tulsa Shreveport St. Louis Los Angeles

Oil Refineries of the World

The tabulation below has been prepared to show the present capacities and status of oil refineries outside the United States where such information is available. No data is given on U.S.S.R. plants or refineries in nations dominated by the Russians. Capacities are in barrels per day. Key to type of plant: S-Skimming; L-Lubricating; A-Asphalt; C-Cracking; Comp.-Complete.

Summary of Refinery Capacities

Operating or Operable Capacities, July 1, 1950

Country	No. Plants	Crude Capacity Barrels Daily	Cracking Capacity Barrels Daily
Argentina	17	129,800	58,620
Australia	6	17,600	2,700
Austria	9	25,510	3,840
Bahrein Island	1	165,000	25,000
Belgium	6	16,500	2,000
Bolivia	3	2,790	—
Brazil	5	3,515	—
British Borneo	1	35,000	—
Burma	2	1,500	—
Canada	32	341,550	151,430
Chile	3	360	—
China	4	19,000	7,100
Colombia	2	30,900	—
Cuba	5	6,080	1,100
Denmark	3	655	—
Ecuador	2	5,700	—
Egypt	2	47,000	6,400
Eire	1	600	—
France	15	293,900	30,450
Germany	23	73,070	10,720
Hungary*	8	23,425	—
India	1	5,500	1,500
Iran	3	572,100	100,000
Iraq	2	9,500	—
Israel	1	83,000	33,000
Italy	28	112,480	15,000
Japan	17	51,127	3,500
Korea	1	5,000	—
Lebanon	1	11,000	—
Mexico	10	201,190	28,650
Netherlands	2	53,500	24,400
Netherlands East Indies	6	146,300	56,000
Netherlands West Indies	3	657,000	366,500
Norway	1	1,000	—
Pakistan	1	5,800	2,000
Peru	3	34,900	6,000
Poland*	6	14,550	—
Portugal	1	7,000	—
Romania*	20	132,750	37,850
Saudi Arabia	1	140,000	—
South Africa	1	2,000	2,000
Spain	3	23,600	4,500
Sweden	4	24,800	2,300
Switzerland	2	1,850	—
Trieste	2	15,800	—
Trinidad	3	99,000	35,000
Turkey	1	1,400	—
United Kingdom	17	206,080	15,300
U.S.S.R.*	25	675,000	250,000
United States	392	6,750,000	3,980,000
Uruguay	1	25,000	1,900
Venezuela	13	287,950	67,500
Yugoslavia	5	11,000	600
TOTALS	727	11,606,632	5,332,860
WESTERN HEMISPHERE	494	8,575,735	4,696,700
EASTERN HEMISPHERE	233	3,030,897	636,160

* Estimated.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Australia:				
Bitumen Oil & Refineries Ltd.	Sydney	3,000	SA	—
Commonwealth Oil Refineries Ltd	Laverton, Victoria	2,500	S	—
National Oil Pty. Ltd.	Glen Davis	1,500	SC	1,500
Shell Co. of Australia Ltd.	Clyde, N.S.W.	8,100	Comp.	1,200
Vacuum Oil Pty. Ltd. (Standard-Vacuum)	Paisley	1,300	SLA	—
	Altona	1,200	SL	—
Bahrein Island:				
Bahrein Petroleum Co.	Persian Gulf[1]	165,000	SCA	25,000

[1] 55,000 BD crude still under construction; to be completed end 1950.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Argentina:				
Cia. General Asfaltos	Wilde (B.A.)	370	L	—
Cia. Nativa de Petroleo	Campana (B.A.)	16,000	SCLA	9,100
	Bahia Blanca	5,000	SCA	2,200
Condor	Avellaneda (B.A.)	1,000	SL	—
Diadema Argentina S.A. de Petroles	Buenos Aires	15,000	SC	8,000
Ferrocarrilera de Petroleo	C. Rivadavia	5,500	Comp.	2,000
La Isaura	Bahia Blanca	1,600	SC	1,000
Loterro y Papini	Avellaneda (B.A.)	300	SL	—
Ragor (Ramon Gorleri)	Quilmes (B.A.)	30	SL	
Standard Oil Co. S.A.	Manuel Elordi	1,100	S	—
	Dadin	400	S	—
Ultramar (Socony-Texas)	Dock Sud-Avellaneda (B.A.)	6,000	Comp.	2,600
Y.P.F.	Puerto La Plata	53,500	Comp.	23,000
	San Lorenzo (Santa Fe)	15,800	SC	6,200
	Lujan de Cuyo (Mendoza)	5,000	SC	3,000
	Chachapoyas (Salta)	1,900	SC	950
	Plaza Huincul (Neuquen)	1,300	SC	570

Refinaria de Petroleos do Distrito Federal S.A., being organized, planning to build refinery.

Austria:				
Anglo-American Group:				
Vacuum Oil Co.	Kagran	2,100	S	—
AG der Shell-Floridsdorfer Mineralolfabrik	Floridsdorf	2,000	SLA	—
Oesterr. Mineralowerke	Lobau	4,850	S	—
Former German Group:				
Benzin-Benzol-Verband	Vosendorf	2,100	S	—
Deutsche Erdol A.G.	Schwechat	3,100	SC	3,840
	Ebensee	1,860	S	—
Deutsche Gasolin A.G.	Korneuburg	2,900	S	—
Donau Oel G.M.B.H.	Moosbierbaum	5,200	S	—
German Govt.	Hauskirchen	1,400	S	—
Belgium:				
"Albatros" S.A. Belge pour le Raffinage de Petrole	Antwerp, Kiel	3,500	S	—
Belgian Shell Co. S.A.	Ghent[1]	1,800	S	—
Compagnie Industrielle "Atlas" S.A. (Esso)	Hoboken-Antwerp	1,500	S	—
Raffinerie Belge de Petroles	Antwerp	7,000	SC	2,000
Raffineries et Distilleries Anversoises S.A. "Radian"	Antwerp	1,700	S	—
Tankage et Transport S.A.	Antwerp	1,000	S	—

[1] Operates on topped crude.

Esso Standard Refining S.A. building 25,000 BD plant at Antwerp, to be completed Jan. 1953.

Soc. Industrielle Belge des Petroles S.A. building plant at Antwerp, to be completed mid-1951; includes 30,000 BD topping, 13,200 BD visbreaking & thermal wax cracking unit, 6,000 BD naphtha reforming unit, three 6,000 BD copper chloride sweetening units, acid treating & re-run units.

Bolivia:				
Yacimientas Petroliferous Fiscales Bolivianos[1]	Camiri	1,380	S	—
	Sanandita	410	S	—
	Sucre	1,000	S	—

[1] For completion end 1950: 5,000 BD topping & reforming plant at Cochabamba.

Chile:				
Johannsen, C. H.	Coquimbo	125	S	—
Maritano, Miguel	Talcahuano	60	S	—
Soc. Establecimientes Quimicos	Vina del Mar	175	S	—

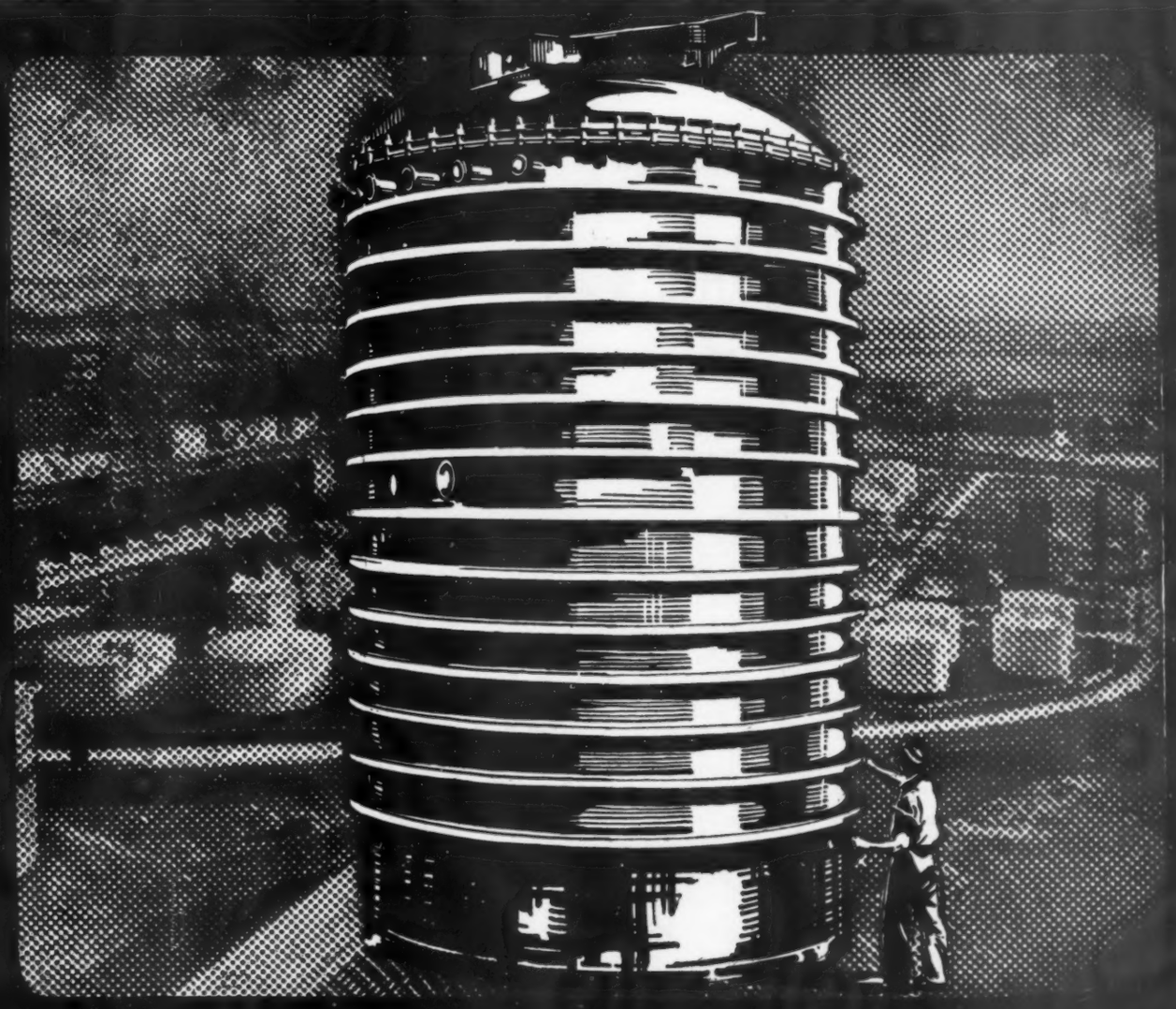
Corp. de Fomento planning plant in Santiago for completion in 1952, 13,500 BD crude & 6,000 BD cracking.

China:				
Chinese Petroleum Corp.	Hulutao, Manchuria[1]	2,000	S	—
	Kaoshiung, Taiwan, For.	10,000	SC	4,500
	Yumen	2,000	SC	600
Manchurian Petr. Co.	Dairen[2]	5,000	SC	2,000

[1] Formerly an alcohol plant; reported rebuilt to run oil.
[2] Prewar capacity; present unknown.

(Please turn to page 94)

Yours the problem - Harveys the answer!



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Harveys fabricate from mild or alloy steels, nickel and clad steel. Shop assemblies range from a few inches to 15' 0" in diameter, pressures from absolute to 3,000 lbs. per sq. in.

If you have plant to be built, consult Harveys for all items of welded plate work. High grade designs can be developed from your specifications. A typical example is the welded Mild Steel pressure vessel illustrated here.

Write for Catalogue WP 750.

Harvey

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Name of Company	Plant Location	Crude Capacity	Type Cracking Plant	Cracking Capacity
Brazil:				
Consuelho Nacional do Petroleo[1]	Bahia	150	S	—
	Mataripe[2]	150	SC	—
Destilaria Rio Grandense de Petroleo S.A.	Rio Grande	415	S	—
Industrias Matarazzo de Energia S.A.	Sao Paulo[3]	1,000	S	—
Ipiranga S.A. Cia Brazilena de Petroleos	Rio Grande	1,800	S	—

[1] Also plan to build additional plants with a capacity of 45,000 BD.
[2] Being enlarged to 2,500 BD.
[3] Planned: 100 BD wax distillate plant.

Refinaria e Exploracao de Petroleo Uniao is to buy 20,000 BD plant in Czechoslovakia, to be erected at Sao Paulo.

Refinaria de Petroleos do Distrita Federal to build 10,000 BD plant at Rio de Janeiro.

British Borneo:				
Sarawak Oilfields Ltd.	Lutong, Sarawak	35,000	S	—
Burma:				
Burma Oil Co.	Rangoon	1,000	S	—
Nathsingh Oil Co. Ltd.	Yenangyaung	500	S	—
Canada:				
Anglo-Canadian Oils Ltd.	Brandon, Manitoba	2,300	SC	1,100
British American Oil Co. Ltd.[1]	Montreal East	32,000	SCA	20,850
	Clarkson, Ontario	10,000	Comp.	4,500
	Moose Jaw, Sask.	6,000	SCA	2,000
	Calgary, Alberta	7,200	SCA	2,500
Canadian Oil Cos. Ltd.	Petrolia, Ontario	4,000	S	2,000
Excelsior Refineries Ltd.	Lloydminster	1,500	SA	—
Husky Oil & Ref. Co.	Lloydminster	7,500	SA	—
Gas & Oil Refineries Ltd.	Hartell, Alberta	2,000	SC	1,000
Hi-Way Refineries Ltd.	Moose Jaw, Sask.	350	S	—
	Saskatoon, Sask.	2,800	SCA	600
	Rosetown	350	S	—
Imperial Oil Limited[2]	Halifax, Nova Scotia	22,000	SCA	9,900
	Montreal East	37,000	SCA	18,000
	Sarnia, Ontario	52,000	Comp.	24,000
	Regina, Sask.	16,000	SCA	7,500
	Calgary, Alberta	10,000	SCA	4,000
	Ioco, Br. Col.	12,000	Comp.	3,000
	Norman Wells, NW Ter.	1,100	S	—
	Edmonton, Alberta	16,200	SC	8,000
McColl-Frontenac Oil Co. Ltd.[3]	Montreal East	43,000	SC	20,500
	Toronto, Ontario	12,000	SC	7,000
New Brunswick Oilfields Ltd.	Weldon, N.B.	300	S	—
North Star Oil Ltd.	Winnipeg, Manitoba	3,700	SC	680
Northern Petr. Corp. Ltd.	Kamsack, Sask.	600	S	—
Radio Oil Refineries Ltd.	East Kildonan, Manitoba	1,000	S	—
Saskatchewan Federated Cooperatives Ltd.	Regina, Sask.[4]	2,000	SC	900
Shell Oil Co. of Canada Ltd.	Montreal East[5]	15,000	SC	7,000
Shell Oil Co. of B.C. Ltd.	Shellburn, B.C.	7,000	SC	3,000
Standard Oil Co. of B.C. Ltd.	Burnaby, B.C.	8,350	SA	—
Trinidad Leaseholds	Port Credit	6,000	Comp.	3,400
Wainwright Refineries Ltd.	Wainwright, Alberta	300	S	—

[1] Constructing plant at Edmonton, 6,000 BD crude, 3,000 BD cracking.
[2] Constructing 10,000 BD plant near Winnipeg, for completion May 1951, including fluid cat cracking.
[3] Constructing plant, with cat cracking, at Edmonton, for completion 1951.
[4] Dec. 1950 capacity will be raised to total of 4,000 BD crude, 1,900 BD cracking.
[5] Planned late 1950: 25,000 BD crude, 10,000 BD fluid cracking units.

Colombia:				
Colombia Petroleum Co.	Petrolea	900	S	—
Tropical Oil Co.	Barranca Bermeja	30,000	SLA	—
Cuba:				
Cia. Exploradora de Petroleo	Jarahuoca	365	S	—
Cia. Petrolera Jarahuoca	Jarahuoca	320	S	—
Cuban Oil Ref. Co.	Cabaiguan	110	S	—
Esso Standard Oil Co. (Cuba)	Belot	5,000	SCLA	1,100
Union Gas Co.	Bacaranao	285	S	—
Denmark:				
AA/S Kalundborg Olieraffinaderi	Kalundborg	530	A	—
Dansk Mineroloiefabrik	Copenhagen	60	SL	—
L. C. Glad & Co.	Copenhagen	65	S	—
Egypt:				
Anglo Egyptian Oil Fields Ltd.	Suez	38,000	SCA	6,400
Reffinerie de Petrole du Government	Suez	9,000	SA	—
Ecuador:				
Anglo Ecuadorian Oilfields Ltd.	La Libertad	5,000	S	—
Ecuador Oilfields Ltd.	Cautivo	700	SL	—
Eire:				
Cork Harbour Oil Wharves Ltd.	Haulbowline Is., Co. Cork	600	S	—
France:				
Comp. Francaise de Raffinage	Gonfreville-l'Orcher[1]	47,000	SC	7,000
	La Mede[2]	37,000	SCA	3,700
Cie de Raffinage Shell-Berre	Petit Couronne	38,100	Comp.	3,250
	Pauillac	4,300	SA	—
	Berre	25,000	Comp.	7,500
Pechelbronn SAEM	Merkwiller	1,400	Comp.	—
Raffineries Francaise de Petrole de l'Atlantique	Donges[3]	15,000	SC	4,500
Raffineries de Petroles de la Gironde	Bec d'Ambes	13,500	S	—
Soc. Cherifienne des Petroles	Petitjean, Morocco	800	S	—
Soc. Generale de Huiles de Petrole	L'Avera[4]	36,000	SC	4,500
	Dunquerque[5]	7,500	S	—
Socony-Vacuum Francaise	N.D. de Gravenchon	11,000	Comp.	—
	Frontignan	20,000	S	—
Standard Francaise des Petroles	Port Jerome[6]	36,800	Comp.	—
	La Mailleraya[7]	500	S	—

[1] Planned for 3rd Q. 1950: 2-stage distillation, 20,000 BD capacity, will not change crude to stills; for 1951: 2,500 BD lube units.
[2] Planned 4th Q. 1950: 20,000 BD topping, raising capacity to 41,000 BD.
[3] Plant equipped for thermal reforming at 3,000 BD. Planned for 1951-52: 15,000 BD topping unit, also catalytic unit & lube plant, with vacuum, dewaxing, extracting & deasphalting facilities.
[4] Planned for 1951: Revamp of Cross cracker to 3,000 BD thermal reformer.
[5] Planned for late 1951: 26,000 BD atmospheric & vacuum distillation unit, 6,000 BD thermal reformer, 1,800 propane deasphalting, 2,400 furfural extraction, 1,500 MEK dewaxing and 1,200 clay treatment units.
[6] Planned for 4th Q. 1951: 1,800 BD propane deasphalting, 1,200 propane dewaxing. For 1952-53, 10,000 BD cat cracker.
[7] Medicinal & technical white oils, greases and special products.

Germany, American Zone:				
Zeller & Gmelin	Eislinger-Wuertemberg	150	S	—
Germany, British Zone:				
Deurag-Nerag Gewarkschaft	Misburg n. Hanover	8,500	Comp.	2,600
Deutsche Erdoel A.G.[1]	Heide	1,500	S	—
	Wietze	1,000	Comp.	—
Deutsche Gasolin A.G.	Dollbergen-Lehrte[2]	1,800	S	—
Deutsche Shell A.G.	Harburg	9,000	SLA	—
	Reisholz	—	S	—
	Grasbrook[3]	—	L	—
	Hamburg-Wilhelmsburg	—	S	—
	Monheim	3,400	SLA	—
Deutsche Vacuum Oel A.G.	Bremen-Oslebshausen	10,500	SL	—
	Schlau-Hamburg	700	Comp.	—
Ebano Asphalt-Werke	Harburg[4]	11,000	SLA	—
Europaische Tanklager und Transport A.G.	Hamburg-Finkenwarder	14,500	SC	7,700
Greiser	Dollbergen	300	S	—
Johann Halbermann	Wilhelmsburg[5]	2,000	S	—
Mineralolwerke Albrecht & Co.	Grasbrook	850	L	—
Oelwerke Julius Schindler	Peine n. Hanover	420	SL	—
	Hamburg	2,800	SL	—
Ernst Schliemann's Oelwerke GmbH	Hamburg	800	L	—
Wintershall A.G.	Salzbergen	1,200	Comp.	420

[1] Rebuilding war-damaged Wilhelmsburg plant.
[2] Planned 1951: 360 BD dewaxing unit.
[3] Lube plant; damaged, under repair; no present production.
[4] Undergoing expansion.
[5] Operating on tops.

Germany, French Zone:				
Badische Anilin & Soda Fabrik	Ludwigschafen	650	SL	—
Germany, Russian Zone:				
Wintershall A.G.	Luetzkendorf, n. Leipzig	2,000	Comp.	—

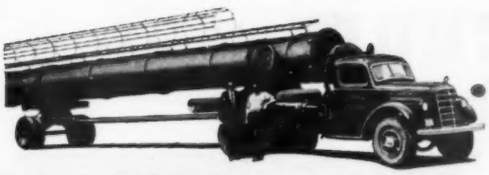
Hawaiian Islands:

Pacific Refiners Ltd. erecting 3,000 BD butane, gas oil & asphalt plant at Honolulu, to be completed late summer 1950.

Iraq:				
Iraq Petroleum Co.	Baba Gurgur	1,500	S	—
Kanaquin Oil Co. Ltd. (Anglo-Iranian)	Alwand	8,000	S	—

[1] Government of Iraq plans to build 1,000 BD plant at Baiji.

(Please turn to page 100)



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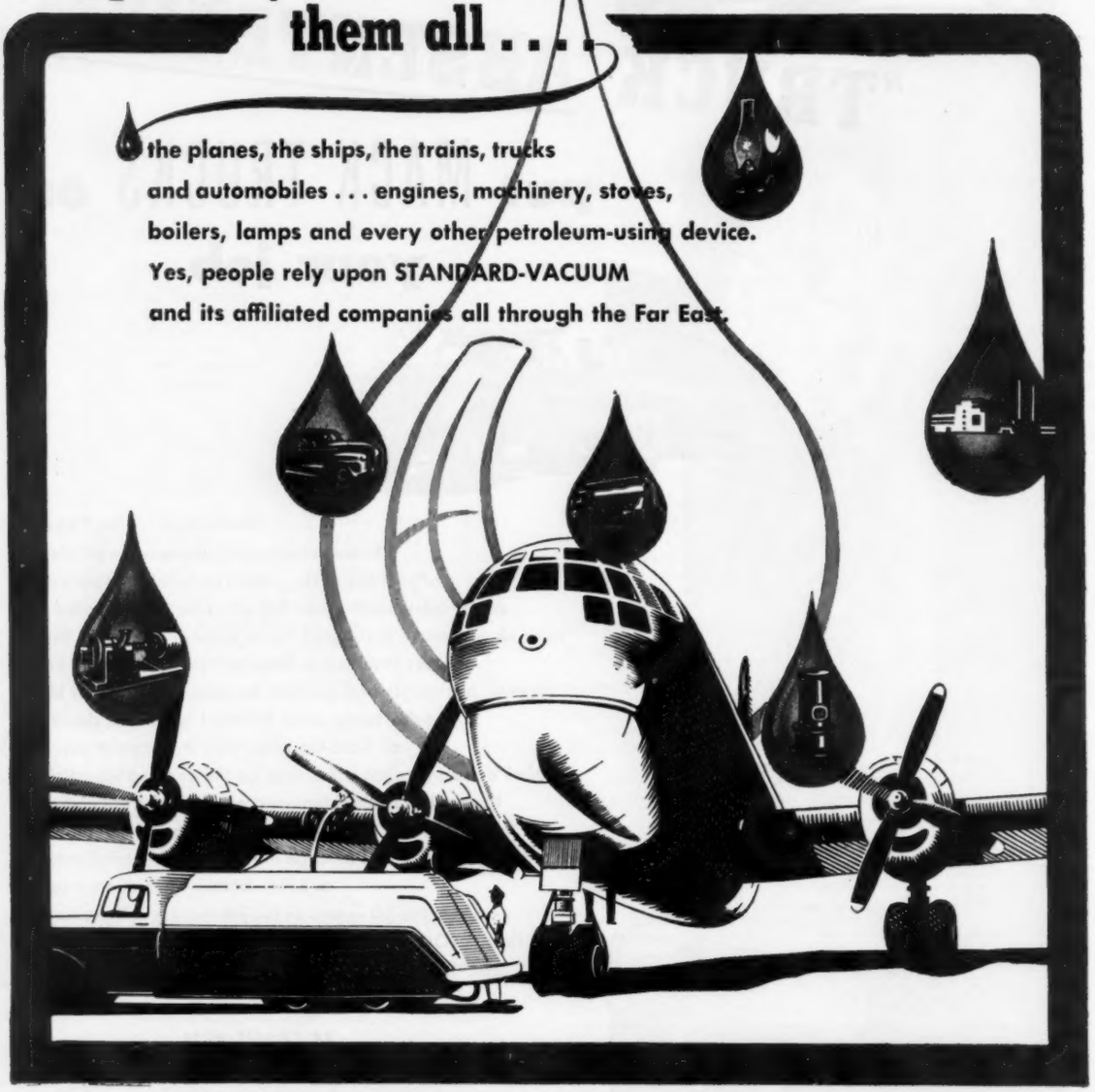
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and automobiles . . . engines, machinery, stoves,
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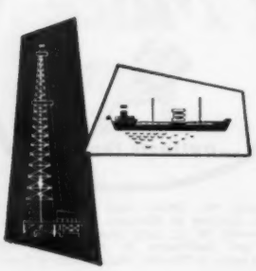

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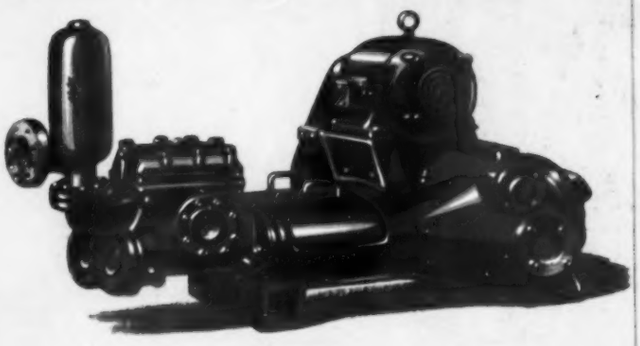
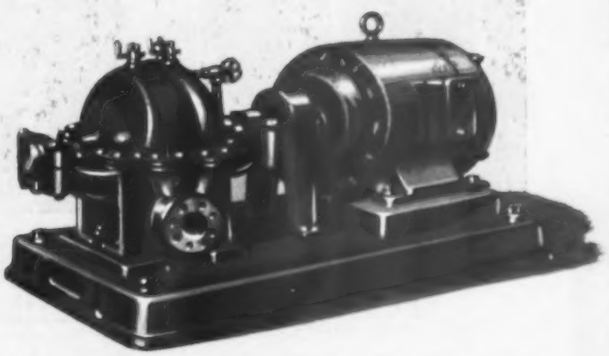
PUMPS

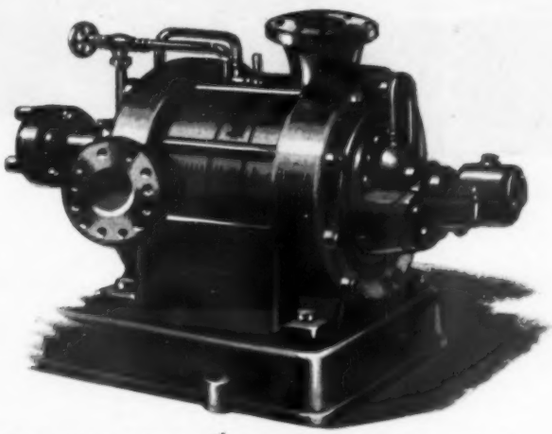
for the Oil Industry



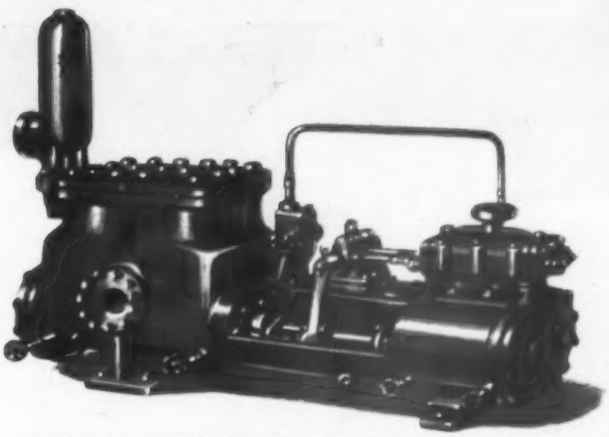
TOTALLY ENCLOSED DUPLEX PUMP for motor or engine drive by gearing, vee ropes or flat belts. A fabricated steel skid type base plate can be supplied if desired. The pump end can be fitted with liners, pistons, valves, etc., to suit any service requirement.



2 STAGE MEDIUM LIFT VOLUTE TYPE PUMP. Made in sizes from 2" to 6" delivery branch for heads up to 250 ft. Normally supplied with cast iron casing and bronze internal parts but special materials can be supplied if desired. For direct or belt drive.



MULTI-STAGE MOTOR DRIVEN PUMPS made in a range of sizes up to 6" diameter delivery branch, with from one to ten stages, suitable for heads up to 1000 ft. Cast iron casings and bronze internal parts. Can be supplied for higher pressures with cast steel casings.



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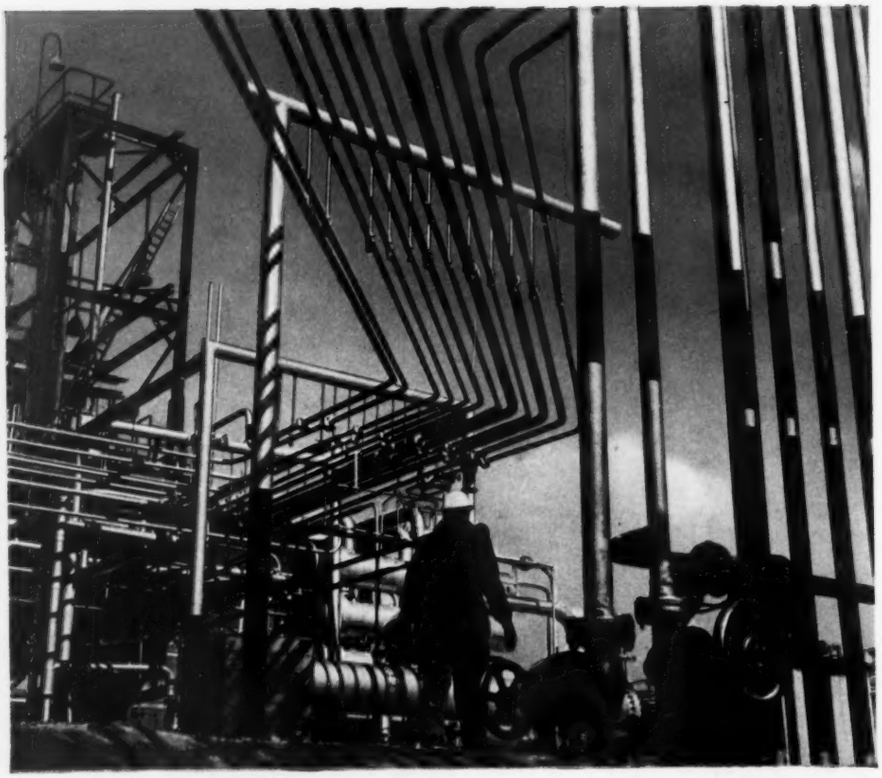

These photographs, by courtesy of Shell Chemical Manufacturing Company Ltd., show S & L tubes at Stanlow, Cheshire.

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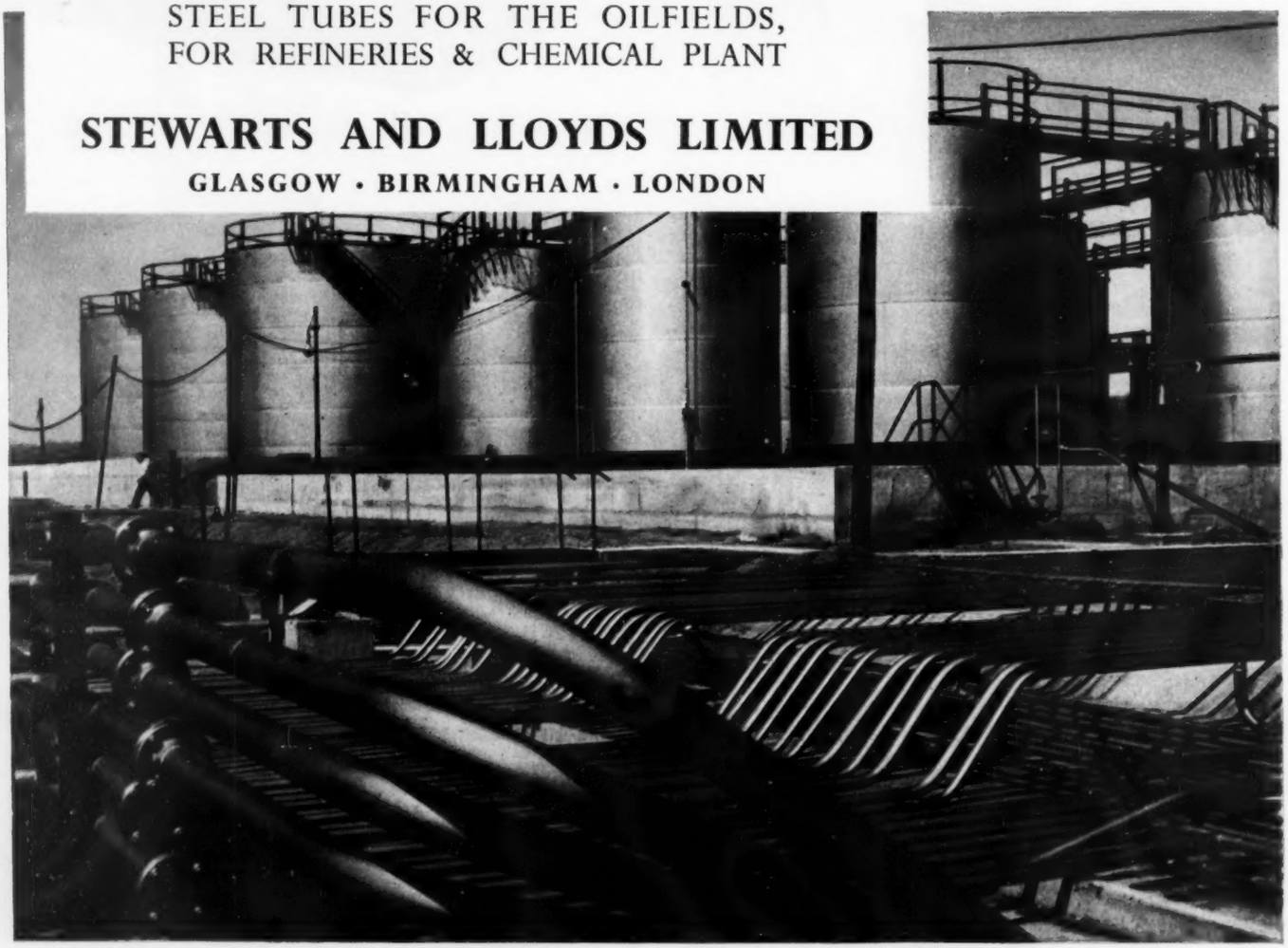

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PROCESS ENGINEERS and CONSTRUCTORS for the PETROLEUM, CHEMICAL and PETRO-CHEMICAL INDUSTRIES

Name of Company	Plant Location	Crude Capacity	Type Cracking Plant	Capacity
India:				
Assam Oil Co.	Digboi	5,500	SC	1,500
Iran:				
Anglo-Iranian Oil Co.	Abadan[1]	500,000	SCA	100,000
	Kerminshah	2,100	S	—
	MIS[2]	70,000	T	—

[1] Planned end 1950: 30,000 BD fluid cat cracker, 400 BD lube plant.
[2] Crude topping plant for Abadan refinery; makes no finished products, ships tops or bottoms to Abadan by pipeline as required for finishing.

Israel:				
Consolidated Refineries Ltd.	Haifa[1]	83,000	SCA	33,000

[1] Shut down.

Italy:				
Anonima Petroli Italiana	Falconara Marittime	300	S	—
Asfalti Bitumi-Catrami e Derivati (ABCD)	Ragusa, Sicily	100	A	—
Azienda Generale Italiana Petroli (AGIP)	Savona	400	S	—
Bianchi Petroli	Cologna, Monza	500	S	—
Distilleria Italiana Catrami Affini (DICA)	Apuania	100	S	—
Distillazione Italiana Combustibili S.A.	Venice, Marghera	5,000	SC	3,500
Delbello Industria del Catrame	Genoa	120	S	—
Galletti	Florence	100	S	—
Garrone	Genoa	100	S	—
Industria Raffinazione Olii Minerali (IROM)	Venice, Marghera[1]	12,000	SC	1,000
Industria Chimica Italiana Petrolifera	Mantova	300	S	—
Idrocarburi Nazionali	Pietramala, Florence	110	S	—
Lombarda Petroli	Villasanta[2]	3,500	S	—
Permolio	Fiorenzuola d'Arda	800	S	—
	Genoa[3]	2,000	SA	—
	Milan	2,000	SLA	—
	Rome[4]	2,000	SA	—
Petroli d'Italia	Fiorenzuola d'Arda	300	S	—
Nazionale Industrie Olii Lubrificaati	Milan	100	S	—
Raffinerie Siciliane Olii Minerali	Augusta, Sicily[5]	10,000	S	—
Raffineria Olii Minerali	Viguzzolo, Milan	500	SL	—
Raffineria Olii Lubrificanti	Tortona	1,000	S	—
Ricerche Alta Italia	Milan	50	S	—
Raffineria di Napoli SAI (Socony-Vacuum)	Naples	33,000	S	—
Societa per la Industria Italiana del Petrolio (Nafta)	La Spezia[6]	11,800	SCA	3,000
Societa Petrolifera Italiana	Fornova Taro, Parma	300	S	—
STANIC (Esso and ANIC)	Bari	16,000	SC	3,500
	Leghorn	10 000	SC	4 000

[1] Taken over from AGIP; planned: 2500 BD thermal reforming, 12,000 BD atmospheric & vacuum unit.
[2] Adding reforming plant, 850 BD.
[3] For completion 1951: cracking facilities, 1500 BD, 1000 BD vacuum still.
[4] For completion 1951: 1500 BD cracking.
[5] Planned: Two-coil thermal cracking & crude distillation unit.
[6] Includes 1000 BD topped crude capacity. Shell has been authorized to build a 40,000 BD plant at Apuania, north of La Spezia.

Note: Condor is building 20 000 BD refinery at Rho, near Milan, for completion 1951.
Soc. Anon. Raffineria Padana Olii Minerali is building 13,000 BD plant at Trecate.
Raffineria Olii Minerali Affini building 500 BD plant at Milan.
Italia building 4,000 BD plant at Cremona.

Japan:				
Daikyo Oil Co.	Yokaichi	1,1550	S	—
Koa Oil Co.	Marifu	5,000	S	—
	Yokohama	500	S	—
Maruzen Oil Co.	Shimotsu	2,000	S	—
Mitsubishi Oil Co. Ltd.	Marunouchi, Tokyo[1]	4,500	SC	2,500
Nippon Oil Company	Akita	4,230	SLA	—
	Hokkaido	207	S	—
	Kashiwazaki	1,260	SLA	—
	Niigata	1,800	SLA	—
	Yokohama City[2]	6,000	SLA	—
	Kudamatsu[3]	5 000	SLA	—
Showa Oil Co.	Kawasaki	5,800	S	—
	Kainau	280	S	—
	Hirasawa, Akita	1,000	SL	—
	Niigata	2,000	SCL	1,000
Toa Co.	Shimizu	4.000	S	—
	Wakayama	6,000		

[1] Planned for Sept. 1951: 2,000 BD vacuum unit, 800 BD clay Rerun unit, 300 press dewaxing, 350 solvent dewaxing.
[2] Planned Oct. 1950: 300 BD furfural extraction, 700 dewaxing, thermal reforming unit to be converted from cracking unit.
[3] Planned Oct. 1950: 500 BD Benzol-ketone dewaxing, deoiling plant.

Korea:				
Russian Government	Genzan (Wansum)	5,000	S	—
Lebanon:				
Iraq Petroleum Co. Ltd.	Tripoli	11,000	S	—

Name of Company	Plant Location	Crude Capacity	Type Cracking Plant	Capacity
Mexico:				
Pemex—Arbol Grande	Tampico	19,000	SLA	—
Cuidad Madero	Tampico	63,000	Comp.	6,050
18 de Marzo	Atzcapotzalco	50,000	SC	13,000
Mata Redonda	Tampico[1]	9,600	SC	5,600
Minatitlan	Minatitlan	26 000	SL	—
Poza Rica	Poza Rica[2]	6,000	S	—
	Salamanca[3]	30,000	SC	4,000
	Nuevo Laredo	330	S	—
	Monterey	160	S	—
	Juarez	1,000	SC	—

[1] Crude unit being enlarged to 15,000 BD.
[2] 150 tons per day sulfur production plant under construction in connection with 100 mmcf gas drying and desulfurization plant.
[3] Under construction; to be completed Oct. 1950, including cracking unit.

Netherlands:				
N.V. de Bataafsche Petroleum Mij. (Shell)	Pernis[1]	33,500	Comp.	18,000
Caltex Petroleum Mij. N.V.	Pernis, Rotterdam	20,000	Comp.	6,400

[1] To be increased to 75,000 BD within five years. Current crude capacity includes crude charged direct to cracking plant. Normal crude distillation capacity 7,000 BD.

Netherlands East Indies:				
N.V. de Bataafsche Petroleum Mij. (Shell)	Balikpapan, N.E. Borneo	9,300	S	—
	Pangkalan Brandan, Sumatra[1]	—	—	—
	Pladjoe, Sumatra	71,000	SC	25,000
	Tjepoe, Java[2]	—	—	—
	Wonokromo, Java	2,000	SA	—
N.V. Standard Vacuum Petroleum Mij.	Palembang, Sumatra	64,000	Comp.	31,000

[1] Inaccessible; former capacity 23,000 BD.
[2] Damaged; rehabilitation under consideration; former capacity 15,000 BD.

Netherlands West Indies:				
N.V. Curacaosche Petroleum Industrie Mij.	Aruba	27,000	S	—
	Curacao	200,000	Comp.	100,000
Lago Oil & Transport Co.	Aruba	430,000	SC	266,500

Norway:				
A/S Oslandske Petroleumscompagni	Vallo	1,000	S	—

Plan to start reconstruction of war damaged refinery July 1950.

Pakistan:				
Attock Oil Co.	Punjab, Rawahlpindi	5,800	SCL	2,000
Peru:				
Cia. de Petroleo Ganzo Azul	Agua Caliente	600	S	—
Empresa Petrolera Fiscal	Zorritos	1,300	S	—
International Petroleum Co.	Talara	33,000	Comp.	6,000
Portugal:				
"Sacor" S.A. Concessionaria de Refinacao de Petroleos em Portugal	Cabo Ruivo[1]	7,000	S	—

[1] Planned: 10,000 BD topping, 5,000 BD cracking, 2,500 BD reforming; also stabilization and polymerization units.

Saudi Arabia:				
Arabian American Oil Co.	Ras Tanura[1]	140,000	S	—

[1] Planned fall 1950: 500 BD asphalt plant.

South Africa:				
So. Africa Torbanite Mining & Refining Co.	Johannesburg[1]	2,000	SC	2,000

[1] Processing shale oil.

Spain:				
"Campsa" Cia. Arrandataria del Monopolio de Petroleo S.A.	Barcelona	600	SL	—
"Cepsa" Cia. Espanola de Petroleo S.A.	Canary Island[1]	18,000	Comp.	4,500
Raffinera de Petroleos de Escombreras, S.A.	Cartagena[2]	5 000	S	—

[1] Building for completion Sept. 1950: MEK benzol dewaxing & percolation plant, 500 BD; propane deasphalting, 700 BD; LPG fractionation.
[2] Planned end 1951: 16,500 BD topping with rerun & stabilizer; 6,000 BD reformer, 350 BD polymerization.

Trieste:				
Aquila S.A. Tecnico Industriale	Trieste[1]	13,500	S	—
Standard Italo Americana Petrolio (SIAP)	Trieste[2]	2 300	SL	—

[1] For completion Oct. 1950: 3,000 BD thermal reforming. For fall 1951: 900 propane deasphalting, 1,350 furfural extraction, 1,000 MEK dewaxing, 800 clay contact.
[2] Includes newly erected 500 BD continuous acid treating plant for lubes, 500 BD continuous white products treating plant, 50 metric tons per day asphalt oxidizing plant.

Name of Co.	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Sweden:				
Johnson & Co., A.	Nynashamm	10,000	Comp.	2,300
	Malmo	1,700	A	—
Koppartrans Oljeaktiebolag	Goteborg	12,000	S	—
Svenska, Skifferolje Aktiebolaget	Orebro[1]	1,100	SC	—

[1] Shale oil plant; LPG plant under construction.

Switzerland:				
Ipsa A.G.	Rotkreuz[1]	1,500	S	—
Schweiz-Sprengstoff Fabrik	Dottikon[2]	350	—	—

[1] Operates on tops.
[2] Manufactures special naphthas.

Trinidad:				
Trinidad Lake Asphalt Operating Co.	Brighton	1,000	A	—
Trinidad Leaseholds Ltd.	Point-a-Pierre[1]	70,000	Comp.	35,000
United British Oilfields of Trinidad Ltd.	Point Fortin	28,000	SA	—

[1] 25,000 BD reduced crude thermal cracking; 10,000 BD naphtha reforming; 15,000 BD fluid cat cracking with vacuum feed preparation unit & visbreaker planned for early construction.

Turkey:				
Maden Tetkik Ve Arama Enstituso	Batman	1,400	S	—
Venezuela:				
British Controlled Oilfields	El Mene de Mauroa	250	S	—
Creole Petroleum Corp.	Amuay Bay[1]	63,000	S	—
	Caripito	67,500	SC	26,000
Mene Grande Oil Co.	Cabimas	1,000	S	—
	Oficina	300	S	—
Shell:				
Colon Development Co. Ltd.	Casigua	1,500	S	—
	La Rivera	200	S	—
	El Calvario	200	S	—
Shell-Caribbean Petroleum Co.	San Lorenzo	41,000	S	—
Venezuelan Oil Concessions Ltd.	Punta Cardon	38,000	SC	30,500
Sinclair Oil & Refining Co.	Puerto la Cruz[2]	15,000	S	—
Texas Petroleum Co.	Tucupita	10,000	S	—
Venezuela Gulf Refining Co.	Puerto la Cruz	30,000	SC	11,000

[1] For completion end 1950: 37,800 BD vacuum pipe still.
[2] To be completed late 1950, capacity raised to 35,000 BD.

Phillips Oil Co. has agreement with Venezuelan government to build & operate modern refinery and wax plant in eastern Venezuela.

Name of Co.	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
United Kingdom:				
Anglo-American Oil Co.	Fawley[1]	20,000	SCA	6,000
Berry, Wiggins & Co. Ltd.	Hoo, Kent[2]	2,000	SLA	—
	Salford (nr. Manchester)	1,500	SLA	—
Briggs & Son Ltd., Wm.	Dundee	700	SL	—
Carless, Capel & Leonard	London	200	S	—
Cory Bros. & Co. Ltd.	Coryton[3]	3,000	SC	—
Lobitos Oil Fields Ltd.	Ellesmere Port[4]	2,500	Comp.	1,000
London & Thames Haven Oil Wharves Ltd.	Thames Haven	2,000	LA	—
Major & Co. Ltd.	Hull	880	SL	—
Manchester Oil Refinery Ltd.	Trafford Park	3,000	SL	—
National Oil Refineries Ltd.	Llandarcy, So. Wales[5]	60,000	Comp.	4,000
Scottish Oils Ltd.	Grangemouth, Scotland[6]	14,000	SC	3,000
	Pumpherston, Scotland[7]	3,700	SC	1,300
Shell Refining & Marketing Co. Ltd. and Starhaven Refineries Ltd.	Ardrossan, Ayrshire	4,300	A	—
	Shellhaven, London[8]	16,600	SA	—
	Stanlow, Ellesmere Port[9]	37,700	SLA	—
	Heysham	34,000	S	—

[1] To be expanded to 110,000 BD.
[2] Planning new two-stage distillation unit.
[3] Owned by Powell Duffryn Ltd., which has made agreement with Vacuum Oil Co. Ltd. to build new refinery, particularly for lube production.
[4] For completion end 1950: 220 BD lube treating; revamping medicinal oil plant; feed preparation plant for cracking unit.
[5] End 1952: 10,000 BD cat cracker; 1,000 BD lube plant.
[6] End 1950: 30,000 BD crude distillation unit. End 1952: 10,000 BD cat cracker.
[7] Capacity includes 2,500 BD for shale oil and 1,200 BD U.K. crude.
[8] End 1950: 45,000 BD 3-stage distillation unit. 1952: reforming & feed preparation units.
[9] For completion 1952: distillation units, cat cracking, reforming, polymerization plants and units for final treatment of various products.

U.S.S.R.:

Before the war there were 13 refineries in Soviet Russia with a crude capacity of 637,500 barrels daily and a cracking capacity of 178,500 barrels daily. The Government has not announced a list since the war.

Uruguay:				
Administration Nacional de Combustibles, Alcohol y Portland (ANCAP)	Lateja	25,000	SC	1,900
Yugoslavia:				
Government	Rijeka	7,000	SL	—
	Sisak	2,000	S	—
	Sumecani	1,000	SC	600
	Basanski Brod	?	S	—
	Belgrade	1,000	S	—

Packaged Cracking Units for Small Refineries

Prefabrication, a by-word in housing and other fields, has entered the petroleum industry in the form of "package" thermofor catalytic cracking (TCC) units to assist small and moderate sized refineries to produce high-octane gasoline competitively for automobiles and aircraft.

Socony-Vacuum Oil Co. Inc., inventor of the extensively-used TCC process for high-octane gasoline, has completed the design features of a small, inexpensive package TCC unit, the company announced June 20.

Heretofore many small refiners have been unable to plan for the high-octane gasoline market because of the cost of conventional catalytic cracking plants, it is explained. The new package unit permits meeting high-octane gasoline requirements with a small plant at a relatively low investment cost.

In TCC refining, charge stock from crude oil is catalytically cracked to high-octane gasoline by passing it through a continually-moving bed of catalyst. The used catalyst is regenerated by removal of the coke deposits and then recirculated.

Socony-Vacuum said the new package TCC units incorporate all the latest developments in the TCC process, including the recently-announced air lift, replacing a bucket elevator for returning the catalyst to the tops of the plants.

The new TCC package unit can be constructed in the customary manner, but a primary objective has been achieved, according to Socony-Vacuum, by designing the unit so that it can be prefabricated entirely in shops and shipped by rail to the refinery site for erection. Prefabrication reduces the time required for installation as well as the cost of the plant.

The package unit has the unique feature also of utilizing a specially-braced but otherwise conventional oil well derrick for the structure. This derrick serves not only as the customary structure for supporting the catalytic cracking equipment in the completed plant but likewise serves as a construction rig while the plant is being erected.

Two sizes of the package TCC units are available, one with a nominal throughput capacity of 3,000 (42-gallon) barrels per day of feed stock, and the other of 6,000 barrels per day.

Southwestern Engineering Co. of Los Angeles (Sweco) has worked out the details for prefabricating both sizes of package TCC units in its shops and is promoting the sale of such units, which it will install.

Sweco offers prefabricated feed preparation, fractionation and stabilization units in proper sizes to go with the prefabricated package TCC units in order to provide completely prefabricated plants for manufacture of high-octane gasoline and is prepared to design and build other auxiliary refinery equipment which may be needed in special cases to implement the TCC unit.

It is estimated that complete prefabricated plants of this type can be installed within 180 to 240 days after the letting of a contract.

Supervised Argentine Construction

John Roge, field superintendent for Catalytic Construction Co., has returned from Argentina, where he supervised the erection of the first of two crude units designed for the Argentine government's La Plata refinery. Mr. Roge, a native of Buenos Aires, has been engaged in engineering in the United States since being graduated from Rensselaer Polytechnic Institute.

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PRESENT TRENDS IN MOTOR FUEL REQUIREMENTS

(Continued from page 61)

50, while the present product or Platformate tests 82 O.N. (F-1).

In considering the fuel needs of the aviation industry, we are faced with the question, "What kind and how much?" Will the transport of 1955 be a turbine-powered aircraft subsisting on a diet of kerosene, or will the reciprocating engine still be predominant in the sky? And if the latter be true, how many grades of fuel, from an octane point of view, will these planes require?

While the British and the Canadians already have prototype jet transports flying and expect to have them in service on their airways within two or three years, it is safe to say that turbines, whether they be powering jets or turbo-props, will not begin seriously to compete with conventional aircraft before 1955. By 1960 the situation may well be revised, and if the prediction of the board chairman of British European Airways, Lord Douglas of Kirtleside, is correct, all commercial planes by that time will be turbojets.

In the United States the airlines have only recently received their new postwar transports, and because of the investment involved, it is unlikely they will be replaced by turbine-powered aircraft before 1955. However, one aircraft manufacturer, Consolidated-Vultee, has already announced that it will concentrate in future on turbo-prop transports. Boeing and Martin are also giving serious consideration to converting their present transports to use turbo-props. Thus we probably shall see a gradual change to turbine-powered propellers beginning in 1955, and the introduction of jets shortly thereafter.

In the interim there will be a demand for jet fuels for experimental purposes and, of course, for the military services. The commercial airlines and the engine manufacturers of the United States, Britain, France, The Netherlands and Canada recently went on record at the technical meeting of the International Air Transport Association as being in favor of using kerosene for commercial turbine transports. The United States Air Force, on the other hand, has chosen to standardize on a wide range jet fuel, JP-3 (MIL-P-5624), because its availability will be greater in time of an emergency.

Kerosene, corresponding to British specification D. Eng. R.D. 2482, was chosen for commercial purposes because it is generally available throughout the world and will be the least expensive fuel available. The oil companies attending the IATA meeting, which was held at Asbury Park, New Jersey, in May, indicated D. Eng. R.D. 2482, or a similar product, would sell for about five cents below the posted airfield price of 100 octane gasoline.

Kerosene production accounts for about six percent of the crude throughput. A. R. Ogston of Esso Export Corp., in an article appearing in the May edition of Esso Air World, estimates that this could be increased to perhaps ten percent by diverting into the kerosene stream certain fractions which would normally be included in motor gasoline, diesel fuel or heating oil. Still further supplies could be obtained, he feels, by modifying cracking processes to give increased yields of product within the kerosene boiling range. Needless to say, this increases kerosene costs.

Many refiners, when it comes to marketing the kerosene-type jet fuel, are at a disadvantage because they use this material in the preparation of special solvents. Years have been spent in building up markets for petroleum solvents, and nothing is to be gained economically by diverting the straight-run distillate to jet fuels, particularly when the net-back is lower. A partial solution to this lies with the smaller refiners who have not the facilities or markets for special solvents. Often they cannot supply kerosene-type jet fuel (British specification DED 2482 or U.S. specification MIL-F-5616) at a price below that which can be quoted by the larger refiners, with their established solvent markets.

While the military have decided, for reasons of availability, to use a wide range jet fuel meeting specification MIL-F-5624, there are certain problems, particularly evaporation and boiling at high altitudes, that may lead to changes in the specification. The British services, contrary to those in the United States, have decided to standardize on the kerosene-type fuel defined by D. Eng. R.D. 2482. Fortunately jet engines are not particularly sensitive to variations in fuels, and if an emergency arose in which British and American jets were operating from the same fields, the segregation of fuel stocks would be unnecessary.

In the manufacture of wide-range jet fuel, it is possible to take a cut with a 600°F end point and also crack the residue to produce further quantities of naphtha and gas oil which can be blended with the straight-run cut. This means that in the case of an emergency, one-half the crude could be diverted to jet fuel—a fact that was recognized by the military in drafting specification MIL-5624.

During the next five years there will be a steady increase in the jet fuel requirements of the military, and the jet engine manufacturers will also be purchasing jet fuels for experimental purposes. Additional refinery capacity to provide fuels for commercial jet transports is unwarranted at this time, since kerosene approximately D. Eng. R.D. 2482 is readily available. Military off-take of wide-range jet fuel is bound to increase, particularly since the United States Air Force has discontinued using the purely kerosene-type fuel. Undoubtedly the industry will undertake to enlarge existing facilities for this type of fuel as the demand grows.

Until two years ago there were only two grades of aviation gasoline used by the commercial carriers, though a third grade, 115/145, was available for the Navy and Air Force. With the introduction of the Boeing Stratocruiser, there arose a demand for a high performance number fuel from the commercial airlines. However, the high lead content (4.6 cc. per gallon) of Grade 115/145 was not entirely satisfactory, and Stratocruiser operators prevailed upon suppliers to make available a fuel with 3-cc. of lead per gallon with a rating of 108/135. It now appears that the Wright engines used on Constellation aircraft may be altered to use Grade 115/145, thus raising the number of grades required by the airlines to four, that is Grade 91/98, Grade 100/130, Grade 108/135, and Grade 115/145.

Obviously the manufacture, transportation and distribution of such a multiplicity of grades is a complicated process, and the duplication of handling facilities increases the cost to the consumer. Since the cost of fuel is one of the major expenditures of the airlines, it is hoped that the aviation industry will take steps to standardize, insofar as possible, on the minimum number of grades.

So far as future developments on reciprocating engines are concerned, we may be fairly sure there will be no commercial demand for fuels having performance numbers in excess of 115/145. Engine manufacturers realize we have reached a high stage of development with this engine, and the next step in the evolution of aircraft power-plants will be with turbine engines. The only improvement to be expected in aviation gasolines is a reduction in lead content without any sacrifice in quality. While the airlines would like this, it is doubtful that they would be willing to pay the necessary premium for such fuels.

Turning to the distillate fuels used by diesels, we see that since 1938 the domestic demand in the United States has risen from 58,000 barrels per day to well over 200,000. Largely responsible for this are the railroads which have switched over from coal and oil-burning locomotives to diesels. In 1948 the railroads consumed 80,000 barrels daily of diesel fuel, and in 1950 it is over 100,000 barrels per day.

It is unfortunate that the railroads are demanding higher cetane number fuels that require stocks needed for kerosene, heating oils and diesel fuels for other applications. If the demand for fuel by the railroads increases at the current rate, it may reach 300,000 barrels per day in 1955, and steps will have to be taken to augment production. Proposals to do this call for a group of 130°F flash fuels which will permit maximum yields of diesel fuel with minimum sacrifice in quality. This will involve more extensive processing of residual fuel oil, a practice that will have the advantage of upgrading these stocks. Economical methods of doing this in small refineries are lacking at this time, but there is every reason to believe they will be forthcoming in time to alleviate shortages. Consideration is also being given to using catalytic cracked distillates in the diesel fuel range by blending them with straight-run distillates. A certain amount of processing to reduce the sulfur content may be necessary, and in some cases it may be profitable to add cetane improvers to the cracked fuels. In the long run it is expected that diesel fuel production will be augmented by synthetic fuels from shale and coal.

There is no doubt that the petroleum industry is entering a period that will see many changes in the demand for petroleum fuels. Balanced refinery operation requires that a careful appraisal be made now of the trends that are already making themselves evident so that future installations and operations can be integrated into the overall scheme with the least disruption. The foregoing summary of fuel trends will, it is hoped, provide a background upon which planning for the next four to five years can be based.

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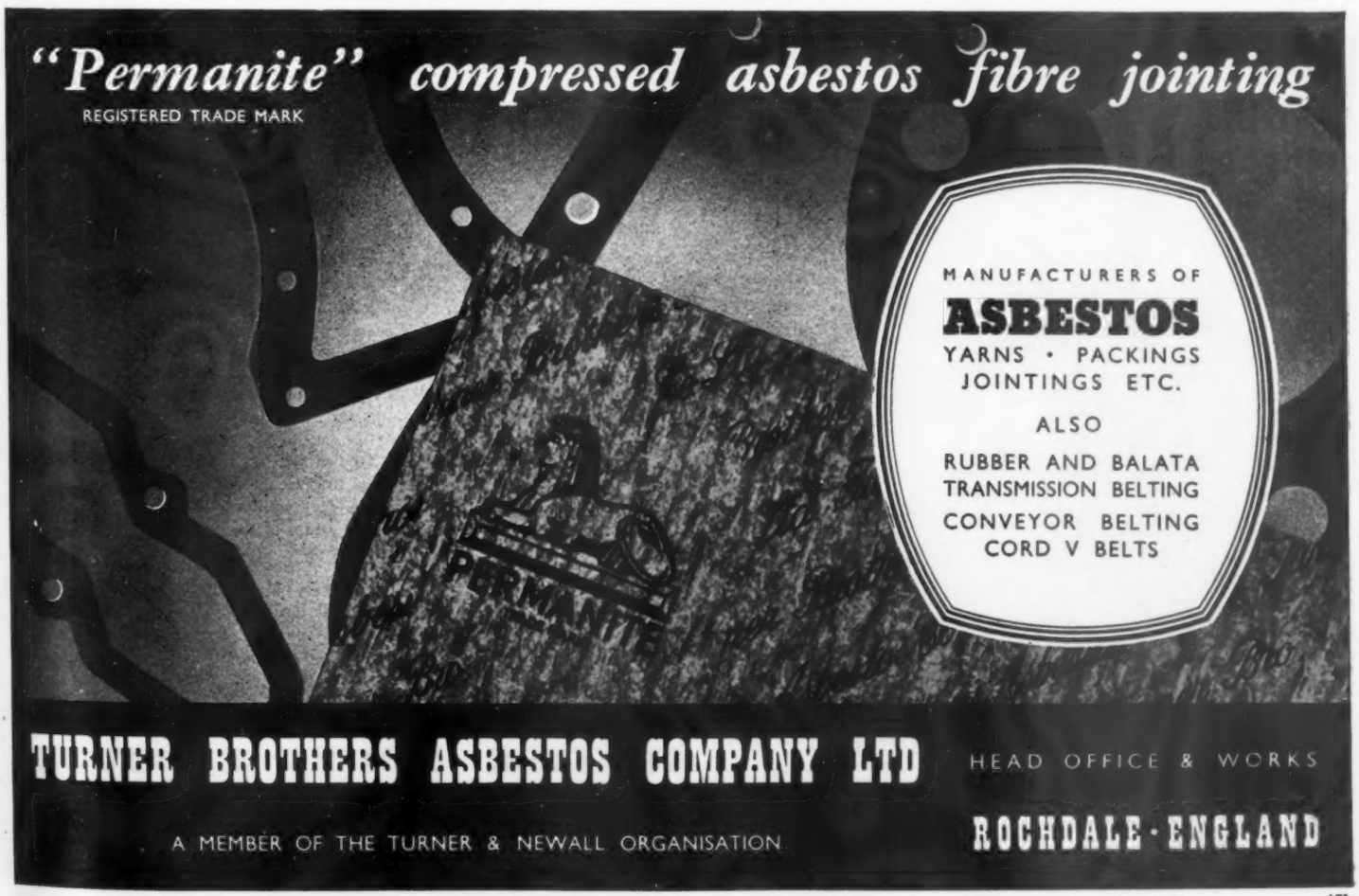

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BRITAIN'S REFINERY EXPANSION

(Continued from page 56)

the charge stock, naphtha in this case, is broken down into gases and liquids. Performance of the individual furnaces shows their effective overall capacity to be in excess of 75,000 tons yearly.

The distillation, rerun and chemical treatment units of the plants are all in operation, the resin and naphthalene units are completed and starting operation. The isopropanol plant is ready to go into operation, and the three remaining units which manufacture products mainly derived from ethylene will shortly be completed.

The balance of heat and power consumption in a plant of this type requires careful planning to ensure full economy in this respect. The steam and power plants are giving results fully justifying the thorough investigation made of the problem.

The boilers, which are of Foster Wheeler marine type built by Richardson Westgarth & Co., were designed for erection in the open. This is not usual practice in Great Britain, but the step seems to have been fully justified by the results obtained. In other respects the power plant conforms to usual practice.

The cracking of petroleum naphtha to form a highly aromatic liquid product and mainly olefinic gases takes place in two stages.

The first stage, breaking down the molecular structure of the naphtha to form lower hydrocarbons, is a highly endothermic reaction; the second stage, formation of a fully aromatized liquid, is practically thermoneutral under isothermal conditions.

The cracking furnace is designed to carry out these reactions in the most effective way. On account of the high temperature at which the first reaction is carried out, the tubes are of 18 percent chromium, eight percent nickel titanium-stabilized stainless steel, with the joints in the hot zone welded with alloyed rods, and are heated by radiant heat from five down-draft gas or fuel oil burners disposed to ensure even heat distribution. The second stage reaction is achieved in the lower part of the combustion chamber where a certain amount of flue gas is recirculated to modify and control the temperature so that the aromatization can take place under essentially isothermal conditions. The residual heat in the flue gas is used to vaporize the incoming naphtha by convection and gives up further heat by passage through waste-heat boilers before going to atmosphere.

Separation of the liquid hydrocarbons into pure products is carried out in normal fractionating plants designed by Petrocarbon Ltd. The complex mixture of hydrocarbon gases produced in the cracking plant, containing about 23 percent ethylene, 22 percent propylene together with hydrogen and some methane, ethane, butanes and butenes, is compressed and cooled to a temperature at which the desirable components such as ethylene are liquefied. The remainder, consisting of hydrogen and a certain amount of methane, is used as fuel.

The liquid components are then fractionally distilled at low temperatures to give pure methane, ethane, ethylene, propylene and propane. The range of temperatures in the fractionating columns is from 50 to 141°C.

Ammonia absorption is used in the first step in the refrigeration cascade and consumes a considerable amount of heat which is applied at 150 psi steam, but the amount is less than would have been consumed by ammonia compressors for an evaporated temperature of 50°C, while a compression system would have cost more and taken longer to build.

The methane and ethylene systems work on conventional compression systems. For technical reasons, vertical compressors developing 60 to 120 hp each are used for the methane, and horizontal machines developing 530 hp each at 110 rpm are used for the cracker gas and ethylene, the speed being controlled by the suction pressure.

When the program for expansion of British refining capacity to a point where it would supply in main part the country's requirements for petroleum products was put forward, the tentative goal set was a throughput of 20 million tons annually. Additions to previous facilities already in operation or to be completed by 1952 will nearly or quite attain this objective. So it may be assumed that the new era in the oil industry of the United Kingdom, with the attendant changes involved in the sources and kinds of supply, is measurably within sight. With recent removal of restrictions on the use of petroleum products and a continuation of improvement in economic conditions, a substantial growth in consumption should result and enable oil to play its full part in the nation's industrial progress.

Reflection of a derrick in crude oil tank—A Shell photograph

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Third World Petroleum Congress Will Meet At The Hague In 1951

THE Third World Petroleum Congress will be held at The Hague, Holland, from May 28 to June 6 inclusive in 1951. Like its predecessors, the Congress is designed to bring together representatives of the oil industry from all parts of the world with the special purpose of presenting a review of the progress and present status of science and technique in the petroleum industry. Plenary sessions and sectional meetings will take place daily during the course of the Congress in the Kurhaus at Scheveningen, seaside suburb of The Hague.

The first World Petroleum Congress assembled in London in 1933, and at that time a permanent council was created to provide a permanent organization capable of arranging programs for subsequent assemblages. The second meeting was held in Paris in 1937. At that time it was decided to have the third convention meeting in Berlin in 1940. Tentative plans for the gathering were prepared at a meeting of the council held early in 1939, but intervention of the war prevented the meeting from taking place. Disturbed economic conditions following the war made it seem inadvisable to attempt an early restoration of the Congress, but last year the council decided that it would be feasible to convene it in 1951 and selected Holland as the host country.

The permanent council, with several vacancies, consists at present of Col. Louis Pineau of Paris, president; D. A. Hough of the Institute of Petroleum, London, general secretary; Col. S. J. M. Auld, Thomas Dewhurst and H. C. Tett for Great Britain; Dr. G. Egloff and two members to be named for the United States; S. Scheer, X. Normand and J. Filhol for France; Dr. J. N. J. Perquin, G. A. Tuyl Schuttemaker and J. A. Beukers for the Netherlands; Prof. P. Erculisse for Belgium. Members for Canada and Venezuela are still to be named.

The organizing committee for the Congress recently announced the formation of a national committee for the United States. This committee is to cooperate in the planning and organization of the Congress so far as concerns the United States, its industry and individual members. It will invite technical experts to prepare papers for the various sections of the Congress. The following have accepted membership on the committee:

Earl Bartholomew, general manager, research laboratories, Ethyl Corp., representing the Society of Automotive Engineers; J. E. Brantly, president, Drilling and Exploration Co. Inc.; F. S. Clulow, vice president, Shell Oil Co.; Dr. W. F. Faragher, Houdry Process Corp.; Dr. Paul D. Foote, executive vice president, Gulf Research and Development Corp.; A. P. Frame, president, Cities Service Research and Development Co.; J. R. Keith, manager, research and development, California Texas Oil Co.; C. G. Kirkbride, Houdry Process Corp., representing American Institute of Chemical Engineers; Dr. E. V. Murphree, president, Standard Oil Development Co.; Dr. L. L. Nettleton, Gravity Meter Exploration Co., representing the Society of Exploration Geophysicists; C. E. Reistle Jr., Humble Oil & Refining Co., representing the American Institute of Mining & Metallurgical Engineers; and Dr. M. E. Spaght, president, Shell Development Co.

A Committee of Honour is in process of formation to consist of officials of various governments and men of prominence in other walks of life, including leading figures in the international petroleum industry, some of whom may be expected to address the Congress. Members of the Netherlands cabinet including the Ministers of Foreign Affairs, Economic Affairs, Education, Arts and Science, have accepted invitations to sit on this committee. The Netherlands government has granted permission to have the formal opening session of the Congress held in the historic Ridderzaal (Hall of Knights) in The Hague.

Programs for the numerous full sessions and technical discussions that are to be held are being prepared by the several committees in charge, and invitations to prepare technical papers are being issued through these committees. Certain general features have been agreed upon, however. Among others it has been arranged that four lectures will be delivered in the course of the meetings by speakers of international reputation. These speakers and their topics are as follows: Prof. J. J. Broeze of the Royal Dutch-Shell laboratory at Delft will speak on "Future Aspects of the Applications of Fuels and Lubricants." Prof. C. Hugel of the Institut Francais du Petrole will discuss "Recent Progress in the Chemistry of Petroleum and Its Derivatives." Dr. C. M. Lees of Anglo-Iranian Oil Co. Ltd. will talk on "The Oilfields of the Middle East." Dr. E. V. Murphree, president of Standard Oil Development Co., will have as his subject "Benefits to the Petroleum Industry from Research."

Aside from the advantages of participating in discussions and meeting fellow members of the oil industry from all parts of the world, visitors will have the opportunity to visit the many points of scenic and historic interest in Holland and to inspect the oil fields at Schoonebeek, the refineries near Rotterdam, and the Royal Dutch laboratories at Amsterdam and Delft, as well as establishments devoted to other industries.

Referring to the importance of the forthcoming meeting, President R. V. Murphree of Standard Oil Development Company, who is a member of the United States committee, says:

"The Third World Petroleum Congress to be held at The Hague next spring is particularly timely considering the growth of crude production operations in the eastern hemisphere and particularly the large expansion in refining capacity being made in western Europe. I had an opportunity to visit France, England and Holland last year and was particularly impressed by the large amount of research in various phases of oil technology, including production of chemicals from oil, that was being carried out in these countries. Much of this work will undoubtedly be discussed at the coming meeting of the Congress, and this meeting will offer the opportunity of discussing not only these developments but advances in petroleum technology from an overall world standpoint. One of the most valuable features of any technical meeting is the opportunity offered for people working in related fields to get together and consider problems of mutual interest. Those attending the Congress will be from many parts of the world, and there will be opportunity for wide exchange of knowledge and experience. Representatives from the United States will, therefore, have the chance of getting a broad picture of what technical advances may be made in the oil industry from the large amount of research that is being carried on outside of the United States."

Members of the organizing committee of the Third World Petroleum Congress are G. A. Tuyl Schuttemaker, chairman; A. A. G. Schieferdecker, vice chairman; J. A. Beukers, treasurer; and J. W. Zwartsenberg, secretary. Offices of the committee are at 30 Carel van Bylandtlaan, The Hague, where intending visitors may obtain full information.

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U. S. REFINERY EXPANSION

(Continued from page 75)

Following the extensive revision and expansion of its large refineries at Richmond and El Segundo, California, in the immediate post-war period Standard Oil Company of California has directed special attention during the past year toward auxiliary plants operated by the company and its subsidiaries.

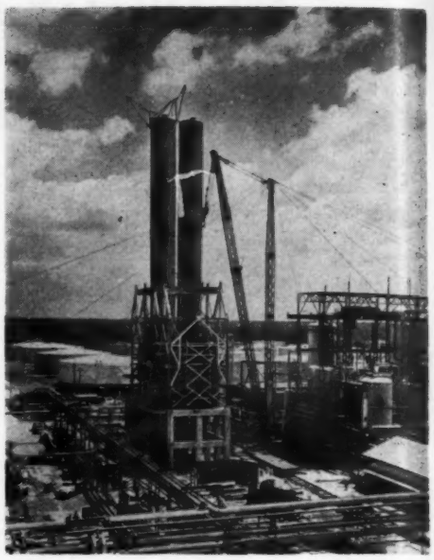
The two principal activities have included a complete rebuilding of the company's Bakersfield, California, refinery, which was concluded in January, and construction of a new plant by its Salt Lake subsidiary as already described. At Bakersfield, new facilities, designed and constructed by C. F. Braun & Co. have replaced units which had been in operation since the plant ran its first batch of crude in 1913, and throughput capacity of the refinery has been increased by 50 percent to approximately 20,000 barrels per day. Now completely modernized, it bears no resemblance to the refinery which operated for many years around a nucleus of the 15 original shell-type stills.

As rebuilt, it now consists basically of a single stage atmospheric tube still, a two-coil thermal cracking unit, a unisol gasoline treater and acid treating and rerun facilities for finishing cracked gasoline. In addition to these, a new administration and laboratory building, shops, and maintenance facilities, and a new boiler plant have been built and additional tankage constructed.

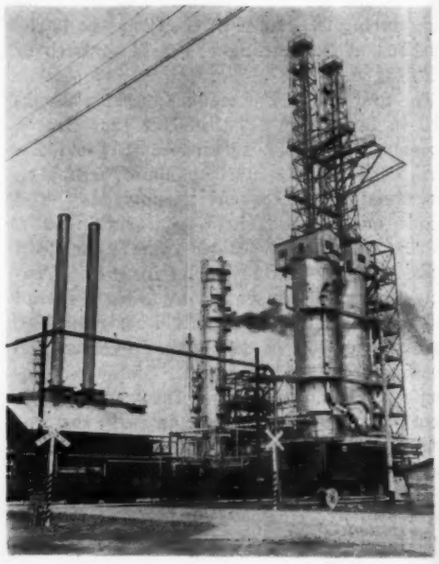
In the northwest another Standard subsidiary, Stancal Asphalt and Bitumuls Company, has just completed the first asphalt refinery in coastal Washington. Located at Richmond Beach near Seattle, and adjacent to Standard's big Point Wells bulk terminal, this refinery has a throughput capacity of 3,500 barrels of feedstocks daily. It is capable of manufacturing 150,000 tons of paving materials annually.

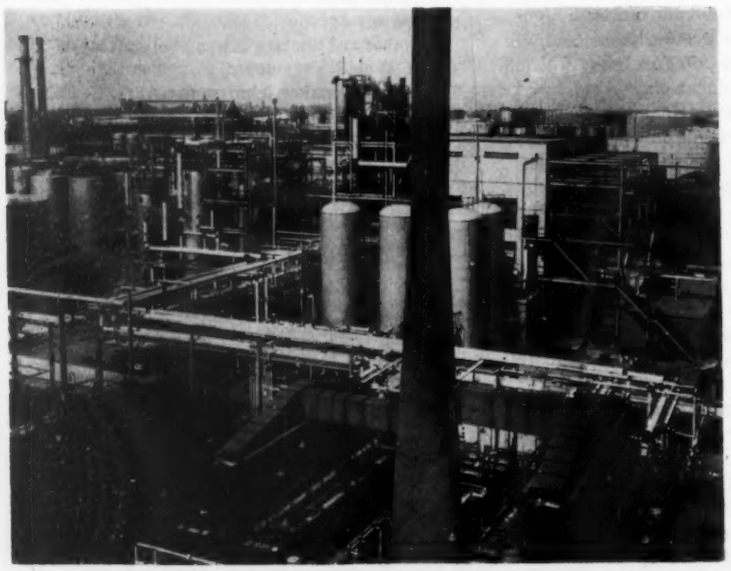
Feed stock for its operation is being shipped by tanker from Standard's Richmond refinery. In addition to these developments, Standard recently announced a long-range program for its Richmond refinery, designed to increase gasoline output and to cut down production of heavy residual oil products. Some work has already been begun on this new program, which involves the conversion of a TCC unit to a Houdriflow process; construction of a vacuum flasher capable of handling 55,000 barrels daily, and the integration of many existing plans into the new processing setup. The whole project is scheduled for completion sometime in 1951.

Catalyst storage bins being erected for TCC unit under construction at Beaumont, Texas, refinery of Magnolia Petroleum Co. →



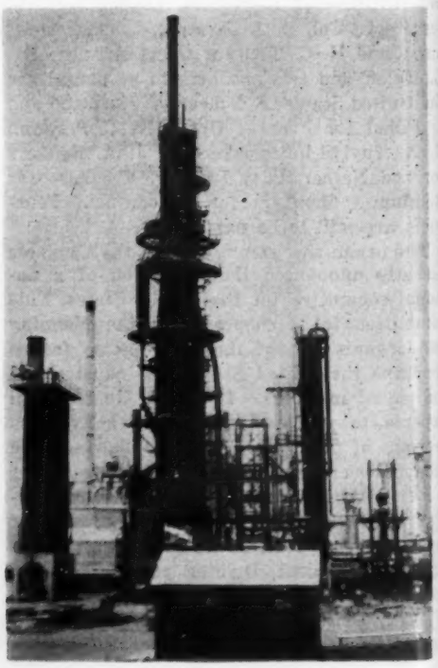
Combination delayed coking and crude topping unit erected for Standard Oil Co. of Ohio at Lima by The M. W. Kellogg Co. →



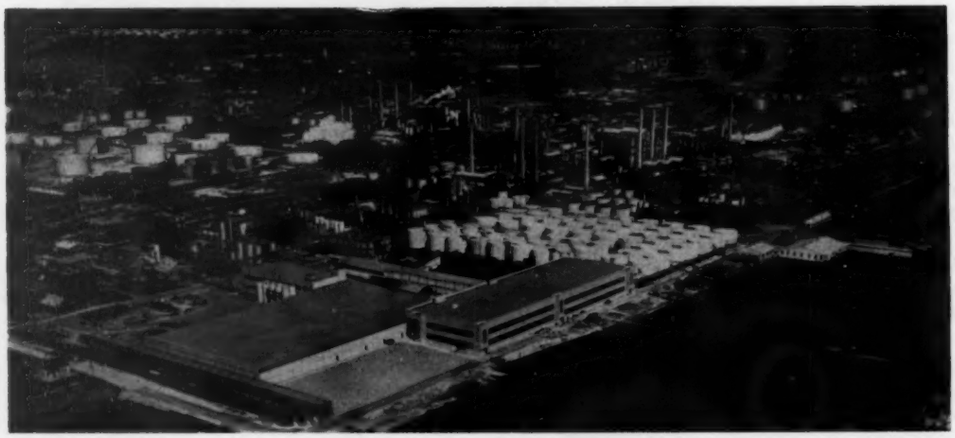


Stack detail at Esso Standard Oil Co. plant, Bayway, N. J. ←

UOP fluid cat cracker installed at Mt. Vernon plant of Indiana Farm Bureau Cooperative Association. →



Sun Oil Company's new $6 million compounding, packaging and warehouse plant at the Marcus Hook, Pa., refinery. ↓



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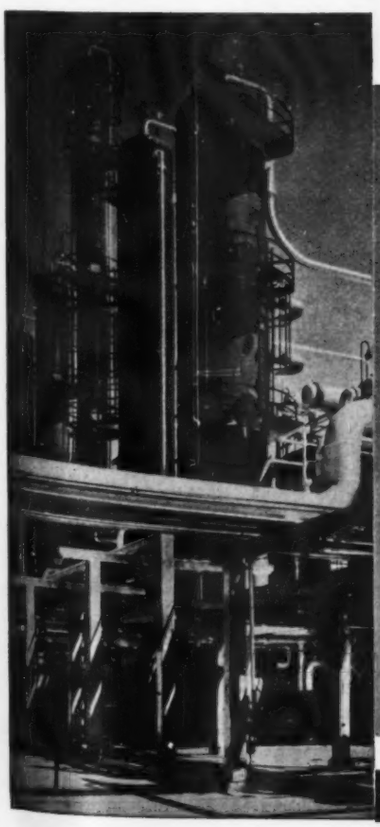

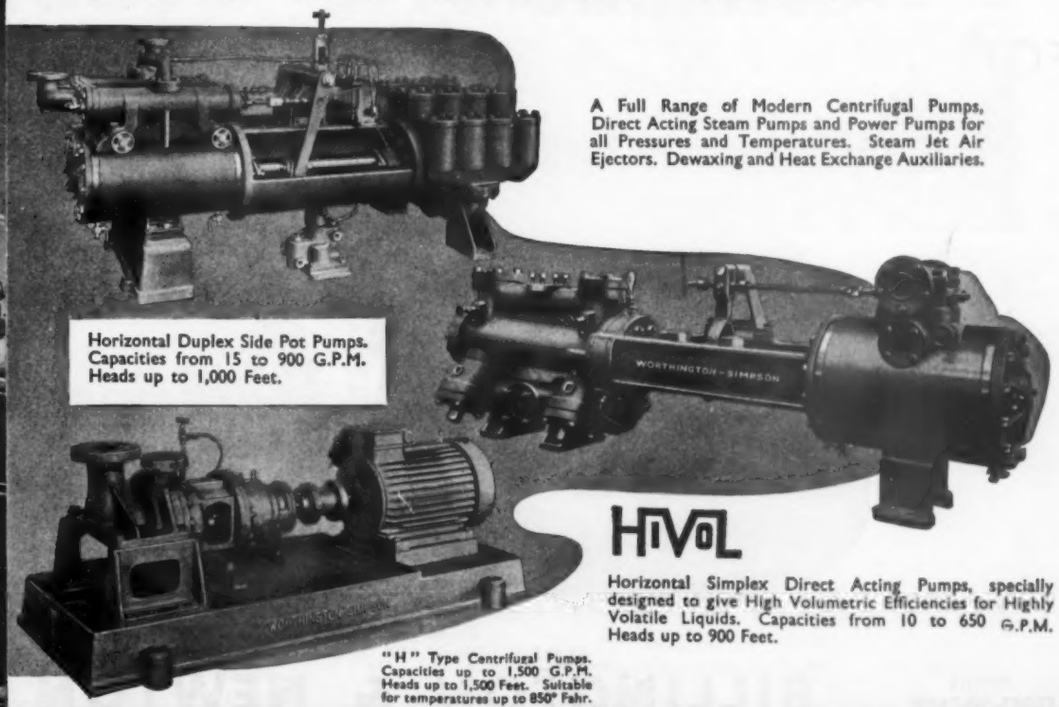

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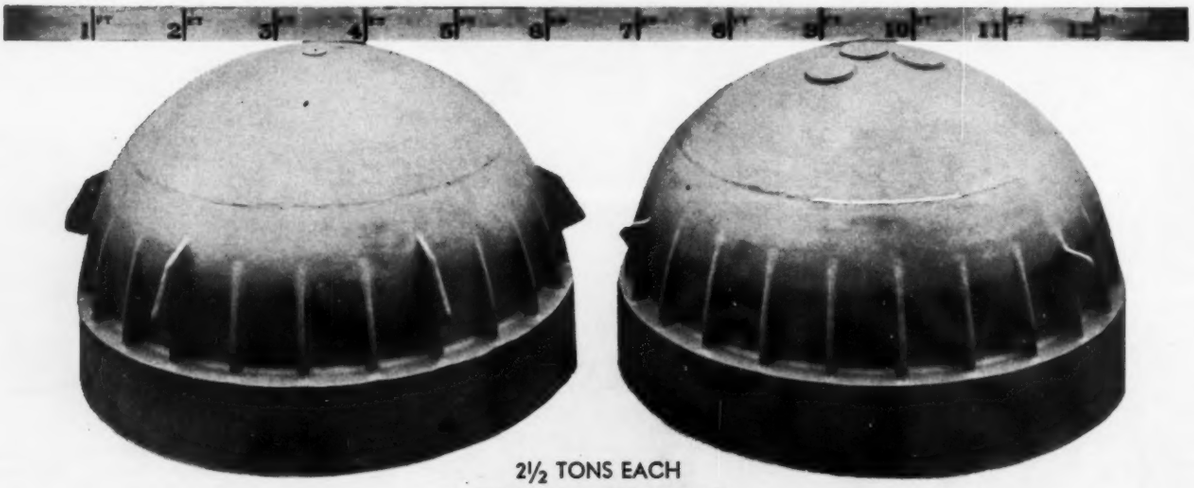

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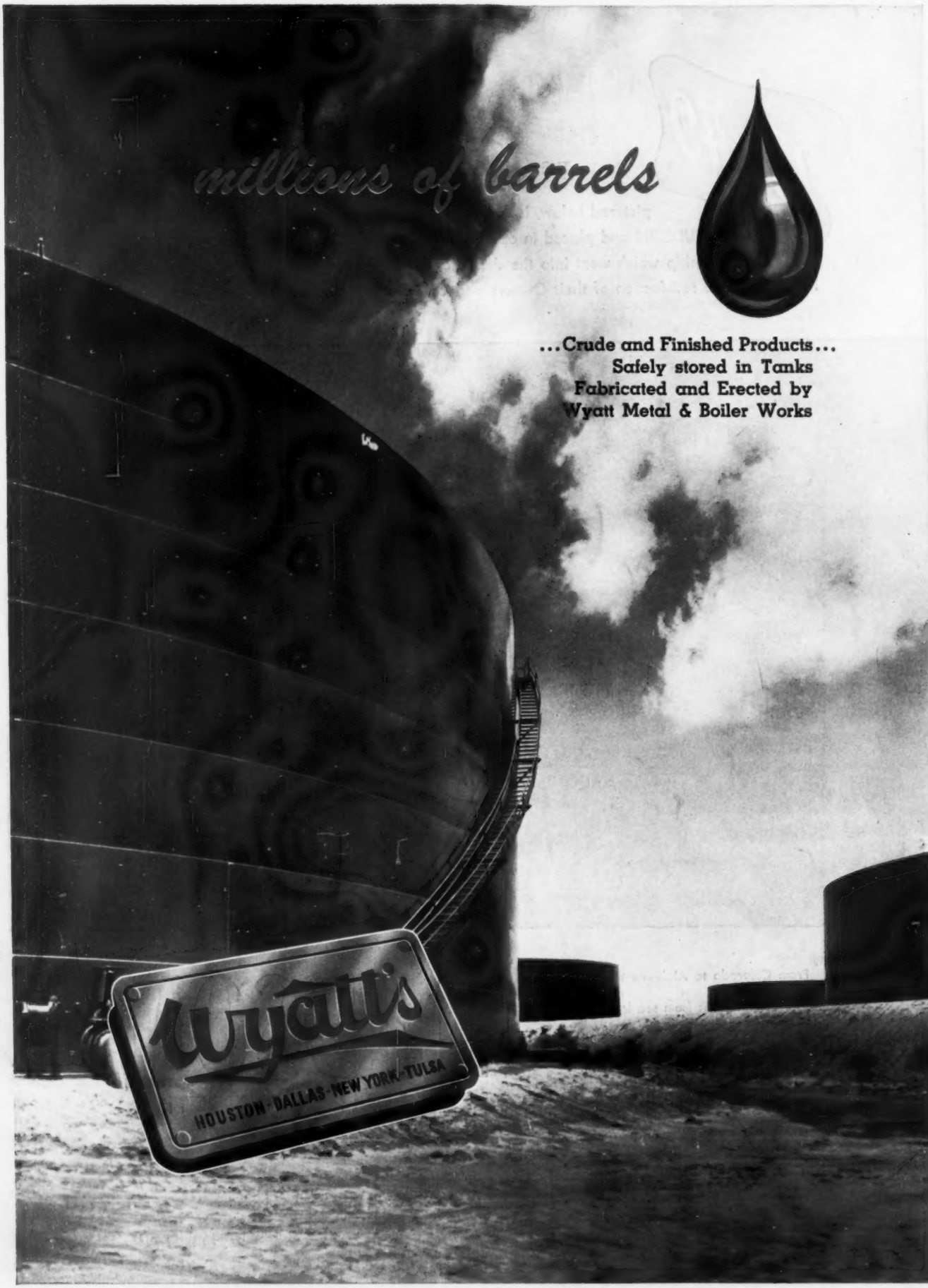
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